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The Glasgow Naturalist

Volume 23 · Part 1 1996

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

The Glasgow Natural History Society

(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow or the Glasgow Art Gallery and Museum.

The present rates of subscription per annum are: for Ordinary Members, £12 (£11 if paid before the A.G.M.); Family Members, £2 extra; Junior Members (under 21), £5; School Members, £1. Payment by Direct Debit is encouraged.

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The Glasgow Naturalist

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Contributions are invited, especially when they bear on the natural history of Scotland. A note of information for contributors is printed on the inside back cover.

A limited number of advertisements can be accepted and enquiries should be sent to the Editor.

Back numbers available are listed on the inside back cover.

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Bound copies of the following may be obtained from the Librarian at the address given on the inside of the back cover and at the prices shown:

The Flora of the Clyde Area (Original printing). J.R. LEE, Price £7.50 to members of GNHS and to the book trade; £10.00 to others (p. &p. 50p extra). This is still the only work of its type and is in diminishing supply.

The Flora of Ailsa Craig. B. ZONFRILLO, 1994. Price £2.50 plus p. & p. 25p.

The Vascular Plants of Northern Ardnamurchan (with additions). R. H. DOBSON, 1983. Price £1.00 plus p. & p. 25p.

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1. *Introduction and Vegetation with a List of Vascular Plants*. R.H. DOBSON & R.M. DOBSON, 1985. Price £1.00 plus p. & p. 25p.

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EDITORIAL

With a new volume, a new editor. I must start by thanking Ron Dobson, who has done the job of editing the *Glasgow Naturalist* through 11 parts and 11 years. I have begun to discover, in taking on the task, just how much work he put into it. Natural History in Scotland will be forever in his debt.

My own credentials for the job are scant: my natural history interests have tended to be abroad, mainly in the West Indies, where I work on the reproductive ecology of amphibians. Perhaps working on the *Glasgow Naturalist* will stimulate me to take an interest in amphibians nearer to home: it will certainly be educational. However, it is fitting that a member of staff of Glasgow University's new Division of Environmental and Evolutionary Biology should be the *Glasgow Naturalist's* editor. The Division involves a fusion of the ecological, evolutionary and taxonomic aspects of Botany and Zoology - which is what modern Natural History is about.

I do *not* intend to institute a radical new policy: the *Glasgow Naturalist* will continue to publish original research and interesting observations on the Natural History of Scotland, made both by professional and amateur biologists. However, we do have a new *look*. After some agonising debate, I was persuaded that the shift to A4 format, favoured by most scientific journals these days, makes sense. Other, minor changes involve some clarification of the instructions to authors and full listing of Short Notes in the Contents.

I am also happy to announce two innovations, aimed at younger (or at least new) writers on Natural History. In this issue, we publish the first winner of the David William Searle Memorial Prize, awarded for an excellent piece of scientific writing by a postgraduate student in the Division of Environmental & Evolutionary Biology. We hope to publish the winning articles whenever they fit with our interests.

Secondly, we announce the institution of the Blodwen Lloyd Binns Prize for contributions on the Natural History of Scotland made by new writers. This is aimed at encouraging the many young people who make interesting observations as part of their degree projects to publish their results - but 'mature' writers can enter, as long as the manuscript is one of the first three they have submitted. Further details are available from me. We hope to publish the first winner of this prize in the next issue.

Finally, please excuse any errors in this edition. I doubt that it will meet Ron Dobson's high standards - but I hope to improve.

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A MONSTER

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The following essay is the first winner of the David William Searle Memorial Prize, endowed in memory of a highly promising research student who loved writing about biology. The award is for the best scientific article written about their research by a graduate student of the Division of Environmental and Evolutionary Biology. Glasgow Naturalist has undertaken to publish any of the prize essays that fall into the journal's field of interest. As more oil from a stricken tanker pours on to the Pembroke coast, with massive damage to wildlife, it is particularly appropriate to read Paul Walton's graphic account of the 'Braer' disaster. (Editor).

One of those vague mornings: post-Hogmanay drizzle forming oily pools in Glasgow's gutters, prickly headache and prickly manners. Some people, it seems, can always rise above - or perhaps circumvent - these situations, and Mark is one. Bright in every sense.

- Did you hear the early news? (you must be joking, Mark). There's a tanker broken-down 20 miles off Shetland.

I cannot remember my reaction, but I didn't believe it would come to much: worse things happen at sea, as it were. Mark, however, was worried. Correctly as usual. A few hours later I was in the library conducting a global literature search on the key words 'oil' and 'bird'. The first reference spewed out by Biological Abstracts CD ROM: 'The melting dynamics of Mozzarella cheese in pre-cooked frozen poultry dishes', from the Tokyo Journal of Food Technology. I was not in the mood. A filthy hulk was breaking up, pouring numberless tons of stinking, lethal crude into, onto, through our study area.

Close association with wild animals is always dramatic. For three summers we had lived and worked with the seabirds of Sumburgh Head. The team had spent thousands of hours staring at the colonies from various, precarious cliff-top hides. We had caught, weighed, marked, radio-tracked, cursed and admired these birds; risen at 3.30 a.m. to spend four hours in a force 9 gale watching shags sleep (shags, it turns out, breakfast at a civilised hour). We had followed the progress of the same pairs from year to year, tracked guillemots which we knew individually as they dived down beyond 100 feet depth, seen green, unfathomable, in a shag's eye. A radio-tagged kittiwake, so delicate in the hand, released into a brewing Westerly. Drinking soup in a boulder-festooned hut, I tracked its movements as it departed to forage, flying straight into the teeth of the storm. Kittiwakes are small. The waves that night were black mountains. That year, all the kittiwake chicks died: sandeels were scarce, and adults could (or, more accurately, would) not sustain the effort required to catch sufficient food for them. We watched the chicks succumb, one by one. And, we saw the same adults return the following year to breed successfully.

Now the unthinkable had happened. The TV news showed the broken monster astride rocks that were unbearably familiar. Our Shetland project had officially ended 5 days before the Braer grounded within sight of the study colonies. New plans had been made, new work started. We watched the dim video, shags, soiled, staggering on the beaches and the roads, and our planned lives were put on hold: we would go back to Sumburgh in the spring. A perfect opportunity for research into the more insidious effects of oil pollution on seabirds, uniquely, with detailed, pre-spill baseline data for comparison. More than this: those were ***our*** shags.

Late June in Shetland is a frenzy of breeding activity. Seabird colonies are noisy, the excitement infecting all comers, avian or otherwise. The smell and the cries put elastic bands round your stomach. In the year of the Braer, a sea-pink spectacular swept the banks, a display outshining living memory and stunning again and again each morning for a month. The oil was fertiliser. And the birds were there, roaring. Sandeels lined the cliff ledges, refused by sleek, over-fed guillemot chicks.

It had taken until now for the truth to sink in: this scene was a distillation of health. In the face of expected misery, relief became a kind of elation. We had never worked harder (three years' work into one) but we partied every night. The breeding performance of the birds was good. There were some effects. Shags, unlike most of the other birds, remain close to the breeding colonies in winter, and so suffered the highest mortality during the spill. The breeding population was halved. Breeding success in shags is, however, very sensitive to the quality (proximity to the sea, shelter from extreme waves and weather, etc.) of the nest-site. The colony before the spill had been 'full', with younger birds having to nest in sub-optimal sites. With the population reduced, better sites became available to the first-time breeders and so their breeding success was comparatively good, leading to a significant increase in the average number, overall, of shag chicks produced per nest. We took blood samples and found kittiwakes to be anaemic (the main toxic effect of crude oil exposure in birds). However, they too bred successfully in the Braer year. And the oil? We did find some eventually, in a small cove near the wreck. We organised a team outing to visit it. Standing bemused in a circle, we regarded the elusive blackened rocks.

Last week a conference was held in the austere halls of the Royal Society of Edinburgh: The Impact of an Oil Spill in Turbulent Waters - The Braer. The opening presentation was a video comprising clips from media reports following the spill. 'Black cloud over Shetland', 'Worst ecological disaster in recent years', a stream of grim hyperbole was greeted with the snorts and sniggers of Scientists with Hindsight: there can be little doubt that those present were consulted in the production of the headlines. There followed accounts of how the scientific community was mobilised at short (actually, no) notice in a hugely complex and difficult task: monitoring and assessing the effects of the spill. The scientific leadership fulfilled its purpose and gave the research effort the evasive and essential element: perspective. The scope and detail of the research itself was, given the circumstances, nothing short of astonishing. How much do we know? In a university library, leaf at random through one of the thousands of journals. We know so much.

There is always some embarrassment at conferences. One speaker had agreed to model the path and behaviour of the slick, and predict the fate of the oil. The models, intricate and hastily contrived, got it wrong. Embarrassment came at the introduction of a new term: hindcast. This is a forecast of what will happen after it already has. The models got this right. The embarrassment was, of course, the audience's, and it was sympathetic. The Braer spill surprised us all. 84,000 tonnes of crude oil spilled on an environmentally sensitive coastline: what happened? The storm of January 1993 was the worst on Shetland's records. Three weeks of continuous south-westerly gales spawned seas of unimaginably violent energy, and the oil, an unusually light form of crude, was emulsified into the water column and transported away by currents. No true slick ever formed. Had the weather, or the time of year, or the type of oil been different, then so too would the effects. Different, but would the predictions have been better? How much do we know? We know so little, and therein lies the excitement and the challenge. And the wonder of it all is that someone, somewhere, will say the same of Mozzarella cheese.

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THE LEGACY OF THE LOCH LOMONDSIDE WOLF

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**'Keep indoors by night and be wary by day,
There's a wolf on the move 'round Buchanan they say'.**

The above are the opening lines to a short poem entitled *The Wolf* composed around the turn of the century by Drymen poet-artist Sam Henry (f.1885-1909). In the poem, Henry describes the paralysing effect on a small Loch Lomondside community brought about by a rumour that a wolf *Canis lupus* L. had been seen prowling around the neighbourhood. Children were kept at home and no one would dare venture abroad during the hours of darkness. That is, until it was eventually discovered that the supposed wolf was nothing more terrifying than a stray rough-coated collie. Sam Henry's observations on the incident were written tongue-in-cheek, but they serve to illustrate the ingrained fear of the wolf which surfaced in the people, though no wolves had roamed wild anywhere in Scotland for over 150 years. Looking back at the Buchanan episode, there can be little doubt that even in the closing years of the 19th century, the ancestral deep distrust of the wolf was still being sustained by the oral tradition. Although today the wolf's undeserved reputation for being both cunning and evil is more likely to be kept going by well-meaning parents capturing the imagination of their children with fanciful stories such as Little Red Riding Hood, the animal's former presence in the Loch Lomond area can be recalled far more interestingly through the district's unusually rich legacy of wolf place names and folklore alongside recorded accounts.

The rural place names which appear on modern maps represent only a small proportion of the many individual names for familiar landmarks which were once in everyday use. Because so many of these early descriptive names have been forgotten and are now lost, it is worthy of notice that the Loch Lomond area can still lay claim to no less than five place names which bear witness to the former presence and probable abundance of wolves. Four of these five wolf place names are spelling variants of the creature's most common gaelic name *madadh*: Lochan a' Mhadaidh (NN 268217), Craig a' Mhadaidh (NN 332139), Craigmaddie (NS 5776), Knockvadie (NS 473801) and Wolf Burn (NS 603836). Hardy (1863) and Harting (1880) both considered neighbouring Stronachon or Stronahaun (NS 463993) -- Ridge of the (Wild) Dog -- to be a further locality named after the wolf.

Another Loch Lomondside place name which has long been associated with the wolf is Balfron (probably Bail'-a-bhroin), which means village of sorrow or mourning (Johnston, 1904). Passed down from generation to generation the traditional story would have us believe that, on one fateful day in the absence of their parents, all the children of the township were killed by marauding wolves. Thomson (1991) on the other hand, has recently suggested that the tale probably originates from the wolf having been used as a convenient scapegoat to explain away any sudden disappearance of an unwanted child born out of wedlock. This less palatable interpretation of a favourite story seems to have been at least partly responsible for Balfron High School ceasing to use a wolf's head in the design of its school badge in 1993.

Continuing the theme of folk tales, where the dividing line between fact and fiction has become blurred, several writers have referred to the deliberate firing of an extensive tract of ancient pine forest to the north of Loch Sloy to clear out an infestation of wolves. This is a story which first came from the imaginative pen of John Hay Allan (1822), alias John Sobieski Stolburg Stuart, and as the alleged eldest grandson of Prince Charles Edward Stuart, claimant to the Scottish throne. That around 1640 a great fire swept north through Strath Dubh-uisage to Glen Falloch and beyond is not in question, as the conflagration appears reliably recorded in the history of the Clan MacFarlane (Lauder, 1853; MacFarlane, 1922). However, the circumstance as recounted in the two latter publications is of a cattle thieves' hide-away near Loch Sloy being torched by the avenging MacFarlanes, but with a sudden strengthening of the wind the fire spread rapidly, burning uncontrollably through the pine forest for several days. Whether the destruction of Loch Lomondside's most northern forest was by accident or design, its effect on the resident or migratory wolf population would have been the same.

Well entrenched in highland folklore is the one-time custom of burying the dead on islands, to guard against ravenous wolves despoiling the graves. In describing his visit to Loch Lomondside in 1776, the Reverend William Gilpin (1789) points to Inchcailloch in the southern half of the loch as one such offshore burial ground. What is unusual for Scotland however, is that there appears to have even been a local belief in lycanthropy -- the ability of a man to take on the physical form of a wolf. The Reverend Robert Kirk (1644-1692) of Aberfoyle draws attention to the alleged existence of werewolves in his famous discourse on the supernatural, *The Secret Commonwealth* (Sanderson, 1976).

All of the historical evidence relating to the wolf in the general area stems from documentary sources which tell of the provisions made for ridding the countryside of a wild creature which was considered a serious threat to domestic stock. Beginning in the Middle Ages, official participation in reducing wolf numbers was initially centered on Stirling and Dumbarton Castles. An example of this is to be found in the Exchequer Rolls of Scotland for the years 1288-1290, which itemise the appointment of one 'hunter of wolves' at Stirling

(Stuart & Burnett, 1878). Until 1975, when Stirling lost its royal burgh status as the result of local government reform, the town's coat of arms included a wolf crouched on a rock known as the 'Wolf Craig'. Dumbarton Castle's involvement in keeping the wolf from the fold is recorded through a system of local taxation which provided the garrison with meal, at least part of which was used to feed the hunting dogs kept at the castle. First mentioned in a charter of 1348, the fourteen townships of Kilpatrick (on lands granted to Paisley Abbey by the Earl of Lennox in 1227) were obliged to make an annual payment of five chalders of 'watchmeal' to the Keeper of the castle. In 1455 the right to levy this tax was annexed by the crown, payment of the watchmeal continuing to be made to the castle authorities. Over the years, this obligation to provide a contribution of meal to Dumbarton Castle gradually changed to an annual sum of money (Fraser, 1874; Bruce, 1893; MacPhail, 1979). As will be shown later, what is remarkable about this particular piece of revenue raising connected with the wolf is that it lingered on well into the late 20th century.

The main onslaught against the herdsman's age-old enemy came with a series of enactments made by the Scottish parliament between 1427-1577, which placed the responsibility for organising repressive measures against wolves onto the barons, sheriffs and bailies. These statutory regulations - which, incidentally, were not repealed until this century (Anon, 1906) - stipulated the seeking out of the wolf's breeding dens to kill the whelps or cubs, four (later reduced to three) full scale hunts per year and the amount of bounty money for every wolf's head presented for payment (Hardy, 1863; Harting, 1880; Fittis, 1891). In practice, compliance with the legislation tended to be passed down the line, in one particular case providing good evidence for believing that the wolf was still present in the northern-most parts of Loch Lomondside in the first quarter of the 17th century. The Barony Court Book of Glen Orchy (Innes, 1855) contains an entry detailing the following estate instruction dated 1621 from Sir Duncan Campbell to all his tenants, which included his second son Robert Campbell of Glen Falloch ..... 'Item it is statute and ordanit that euirie tennent within the saidis boundis respectiue mak four croscattis of irone for slaying of the wolff yeirly in tyme cuming, under the paine of four pundis money toties quoties incais of failyie' (croscatt: believed to be a stabbing spear with a short cross-piece set back from the point as a stop to prevent the weapon passing right through the wolf's body, which would increase the risk of injury to the hunter through close contact with the wounded animal - see Blackmore (1971) for examples. The specification of iron in the making of the weapon may be significant, for there is an old highland superstition that the metal protected its user against harm). Unfortunately, there is no recorded date when the wolf was finally expelled from Loch Lomondside, but it can be reasonably assumed that banishment almost certainly followed the burning of its last secure refuge within the native pine forests of Strath Dubh-uisage and Glen Falloch in the mid 17th century.

This was not quite the end of the wolf's story in the area however, for in 1706 we find the Duke of Montrose (who in 1702 had purchased the feu superiority of the lands of Lennox, including all mails and duties payable to Dumbarton Castle) pursuing the 'heritors, vassals and portioners of the fourteen tounes within the royalty of Kilpatrick' in the Dumbarton sheriff court for payment of the watchmeal in kind. Having become used to paying the tax in ready money, the defendents argued that a meal levy was an anachronism, particularly as there were no longer any wolves left in the Kilpatrick Hills to necessitate the keeping of dogs to hunt them down. Their plea fell on deaf ears, and again in an appeal to the Court of Session in 1712 (Fraser, 1874; Bruce, 1893; MacPhail, 1979). The watchmeal saga then leaps forward a hundred or so years, with the Kilpatrick superiority having been bought-up by a wealthy mill and factory owner, William Dunn of Duntocher, who used the individual freeholds to set up some of his political supporters as 'parchment barons' to qualify them for the vote (the use of 'paper freeholds' as a qualification for the vote was abolished by the Reform Act of 1832). William Dunn died in 1849, although the estate was not finally wound up until 1873, by which time all but one of the Kilpatrick owners and occupiers had taken up the option of buying-out their obligation to pay the watchmeal duty. The sole unredeemed share of the right to exact payment of the watchmeal tax (which had again been commuted to money) was acquired by the lawyer acting for the Dunn estate trustees, David Murray LL.D of Cardross. Dr Murray, who was also a well known historian and bibliophile, purchased the remaining feu superiority as an antiquarian curiosity. Fifty-five years later on David Murray's own death in October 1928, this superiority, together with his library of local books and papers, was bequeathed to Dumbarton Public Library as 'The Watchmeal Collection' (MacPhail, 1979; Murray, 1933). Right up to 1975, when Dumbarton (like Stirling) lost its burgh status through regionalisation, the annual income from this surviving portion of a local tax once levied to control wolves, was used by the library to add the occasional book to the Watchmeal Collection.

ACKNOWLEDGEMENTS

My thanks go to Graham Hopner of Dumbarton District Libraries for his invaluable assistance in unravelling the origins of the 'Watchmeal of Kilpatrick' bequest. I would also like to record my indebtedness to the late Dr I.M.M. MacPhail, whose scholarly research into the history of Dunbartonshire has paved the way for so many local studies.

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The Wolf, from Harting's *British Animals extinct within Historic Times* (1880).

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STRATHCLYDE UNIVERSITY HERBARIUM – COMPUTERISED DATABASE

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INTRODUCTION

Since 1991 the Herbarium of the University of Strathclyde (Herbarium Code GGO) has been housed at Glasgow Museum and Art Gallery, Kelvingrove, on a long-term loan basis. The history of the Herbarium is described in great detail by Professor Blodwen Lloyd-Binns (BLB) in an earlier volume of the Glasgow Naturalist (Lloyd, 1964).

BLB discusses how, in the 1950's, the Herbarium was discovered after having been 'lost' for nearly 50 years. For the next 20 years BLB carried out a great deal of research on the collections, including the production of a comprehensive manuscript catalogue of the estimated 9,500 specimens.

The herbarium was begun with the collections of Professor John Scouler (1801 - 1876) and Professor Roger Hennedy (1801 - 1876). The other main contributor was Professor Scott-Elliot who was in post from 1896 - 1911 and compiled a herbarium of Gymnosperm cones, bryophytes and lichens collected by himself, his students and fellow members of the societies which formed the Andersonian Naturalists of Glasgow (now GNHS).

BLB divided the Herbarium into three parts, named in honour of the three main contributors to the collections (the use of Scott-Elliot's name appears in the manuscript catalogue for the Cryptogamic Herbarium but not in the 1964 article):

1: The Hennedy Herbarium: native phanerogams
2: The Scouler Herbarium: exotic phanerogams
3: The Cryptogamic Herbarium: native and exotic

In making her substantial bequest to the Glasgow Natural History Society (GNHS), BLB imposed no conditions but listed, to PM, a number of projects in which she was deeply interested and which she hoped would be accomplished. One of these was the computerised cataloguing of the Herbarium. In her late seventies BLB had purchased a computer and was learning to use it in anticipation of cataloguing the collection.

In view of the wishes of the benefactor, one of the first actions of the GNHS Trustees of the Bequest was to commission the cataloguing, on computer, of the Hennedy Herbarium. This was undertaken by KW in 1994. The trustees subsequently agreed that J.A. McMullen should be employed to catalogue the bryophyte part of the Cryptogamic Herbarium.

METHODOLOGY

The catalogue, produced manually by BLB, was used as the primary source for data entry into the computerised databases (using Ashton-Tate's dBase V4.1 on the GNHS computer). The draft database print-outs were checked against the individual specimens and edited as necessary. Vice-county (VC) numbers were also added following the checking of localities in gazetteers and maps.

The database structure follows that used for the computerised catalogue of the British (vascular plants) Herbarium (GL) of Glasgow University's Botany Department. This allows compatible searching of data fields, in effect combining the information for the vascular plants. The future cataloguing of Glasgow Museum's Herbarium (GLAM) will result in all the institutional vascular plant collections in Glasgow occurring on a single database (of c. 70000 specimens).

A few problems arise by following the original database structure, as many fields were not well designed, and therefore searching for data can be impeded; however the modern day speed of computers in some measure compensates for this. The collector's name is an example of a poorly designed field (although it should be possible to amend this in the future with a suitable program).

Separate reports, following the same format, have been produced to accompany the two databases. They both include computer generated indices of the most important fields:

1. Species name ordered alphabetically
2. Localities ordered alphabetically
3. Vice-counties with localities ordered numerically
4. Collectors ordered alphabetically
5. Collections ordered alphabetically

The assistance of Richard Weddle in generating the indices is gratefully acknowledged.

Copies of both reports and computer disks have been placed in the GNHS Library at the Mitchell Library.

HENNEDY HERBARIUM SUMMARY

The Hennedy Herbarium, in total consists of 2189 specimens, all but a few from the British Isles (a few overseas specimens being mounted on otherwise British sheets). The collection represents approximately 1222 species or other taxa.

Information on the individual specimens varies, but in common with many old specimens, locality details are unfortunately often all too sparse. There are 601 sheets containing no locality information; many of these may be attributable to an unknown person who trimmed many sheets, so that they would fit neatly into boxes (BLB refers to this person as the 'vandal'!). The remaining specimens contain various degrees of information and this allows the computer to search fields not normally easily accessible in manual catalogues.

The named localities range across the British Isles including specimens from 13 Irish VC's (several from H28 and H39 - Sligo and Antrim areas). There are collections from 49 of the 71 English VC's (plus the Channel Islands); there are 10 or more sheets from VC's 1, 17, 34, 38, 55 and 61. There are specimens from 31 of the Scottish VC's: 72, 73, 74, 75, 76, 77, 80, 81, 82, 83, 85, 86, 87, 88, 89, 90, 92, 95, 96, 97, 98, 99, 100, 101, 102, 103, 105, 106, 108, 109 and 111.

The Scottish localities include many of the favoured haunts of botanists last century such as Possil Marsh, the Cathkin Braes and along the Clyde Valley. There is also a strong interest in the Clyde estuary area with a number of collections from Gourock, Helensburgh and Cumbrae. Classic Scottish sites such as Ben Lawers and Clova are also well represented.

In total 140 individual collectors contributed to the Herbarium and there are 560 sheets with unknown collectors. Over 1/3 are attributed to Hennedy (793 sheets) with other important collectors being Scouler (147), A. Bloxam (104), Leakey (114), W. Gourlie (40) and J.H. Balfour (30).

The Hennedy Herbarium comprises specimens from at least 12 individual collections, with 1281 from Hennedy. The next largest is Scouler with 356 sheets but there are substantial numbers from Leakey (114), Couper (122), Scott-Elliot (83) and the Watson Exchange Club (131).

CRYPTOGAMIC HERBARIUM:

BRYOPHYTE SUMMARY

In total 1495 specimens have been catalogued. In 125 cases the identification is unknown and many others have incomplete information. The collection comprises about 460 species or other taxa, with the number of any one species ranging from one to 22 specimens (averaging three).

In contrast with the Hennedy Herbarium, overseas collections are well represented. The wide range of global localities include 35 specimens from Vancouver and a further 33 from other American localities (reflecting Scouler's travels early last century). There are also specimens from Africa (17), China (5), Hawaii (4), Jamaica (5), India (28), New Zealand (25) and a small number from European localities.

There are 749 specimens from Scotland, but only 57 from 16 English VC's (all less than 10 specimens) and only six from Ireland. The Scottish VC's are 72, 73, 75, 76, 77, 80, 82, 83, 85, 86, 87, 88, 89, 90, 92, 94, 97, 98, 99, 100, 103 and 112. Renfrewshire, Lanarkshire, Dunbartonshire and Argyll are well represented, and Cumbrae, with 51 specimens, reflects Hennedy's interests. There are also a number of specimens from montane localities such as the Cairngorms, Ben Lawers and Ben Nevis. The locality is unknown in 536 cases.

The collector is unknown in 436 instances. A total of 71 individuals have contributed to the collection, the largest being Hennedy with 330, followed by Scouler (206) the other nineteenth century botanist in whom BLB took a great interest. Scott-Elliot is accredited with 61 sheets.

The Hennedy collection comprises 546 specimens, that of Scouler 317 and of Scott-Elliot 252. Three other contributors had collections with species numbers ranging from 2 to 42.

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ALIEN CRANE'S-BILLS IN LANARKSHIRE

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This article reports the occurrence of alien crane's-bills in Lanarkshire (VC77), the author being the plant recorder for the vice-county. Where no credit for the discovery is given, the record is that of the author. The first recording given in each case represents the first recording in the vice-county.

French Crane's-bill *(Geranium endressii)*
The first records of this plant are those of R Mackechnie in 1957 from both the Johnston and Bishop Lochs. Later in the same year it was recorded from near Lanark, by W A Scott, but without a precise locality. I have been unable to find the plant at either of the loch sites. The first of the more recent records was in 1983 from a wood between Glasgow and Renfrew in that part previously referred to as "Lanarkshire's Nose" (Macpherson and Teasdale, 1986). In 1989 it was seen on open grassland at Shiels and in 1993 it was discovered in rough grassland at the edge of the wooded gully near Burnside, a wood at Carmyle and near Drumclog. Abortive development destroyed the first site in 1991 but it persists at the other four.

Himalayan Crane's-bill *(Geranium himalayense)*
Plants were seen in stony waste ground (1992 and 1994) in two different areas at the site of the 1988 Glasgow Garden Festival. In addition there was one plant which was probably the hybrid G. himalayense x G. pratense. In the effort to make the site more attractive to possible developers the area was bulldozed in late 1994 and the plants lost.

Rock Crane's-bill *(Geranium macrorrhizum)*
This plant is known to have been part of an exhibit at the Glasgow Garden Festival, but plants were noted in a "wild state" in 1992 on a residual grassy bank and persist. In 1995 a single plant was noted as a result of dumping of garden refuse on a bank at Burnside.

Dusky Crane's-bill *(Geranium phaeum)*
Hopkirk (1813) recorded this plant from Blantyre Priory as did Balfour (1844). Lee (1933) reported it from the same location and also from Bothwell. We have no recent records from Bothwell but about 1990 J.R.S.Lyth saw it in very small quantity on the bank of the River Clyde near the Priory. In 1980 I had seen it at a pathside by the River Clyde at Cambuslang where it is established and it has recently been seen at the Murray, East Kilbride (B. Simpson).

Armenian Crane's-bill *(Geranium psilostemon)* (plate – see front cover).
This plant was first seen in 1993 on grassy waste-ground at the site of the Garden Festival. It was still present and increasing in 1994 until that part of the site was bulldozed in the autumn of that year. It was however noted in another part of the site in 1995. It was seen in 1994, just within a wood near Burnside, where it is established.

Bloody Crane's-bill *(Geranium sanguineum)*
Plants were present on waste ground at the Garden Festival site in 1991 but subsequently destroyed. In 1993 a little colony was seen at the edge of a field at Peel and on waste ground at an abandoned industrial site at Dalmarnock. It is persisting on both sites.

var *striatum* was first seen on grassy waste ground at the Garden Festival site in1993 and persists.

Druce's Crane's-bill *(Geranium* x *oxonianum* = *G. endressii* x *G. versicolor)*
The first record is that of Birnage in 1968 from a coup at Dalserf (Macpherson 1991). The first naturalised record is from a wood at Thorntonhall in 1989. Plants had spread to or been bulldozed to various parts of the Garden Festival site (three different 1km squares) in the years 1991-93. Established plants were noted in a wood at East Kilbride in 1992 in a similar habitat in Rutherglen in 1993 and in a different 1km square in Rutherglen in 1994. Keith Watson has records from near Baillieston (1990) and Cairnhill, Airdrie (1993).

Purple Crane's-bill *(Geranium* x *magnificum* = *G. ibericum* x *G. platypetalum)*
In 1981 A McG Stirling and A J Silverside reported the plant from the Cuningar loop. My first record is from a road-side near Carmunnock in 1985 and the second from woody waste ground at Cambuslang in 1987. Since then I have made six further 1km records and many others have been submitted by J.H. Dickson and K. Watson.

Hedgerow Crane's-bill *(Geranium pyrenaicum)*
There is doubt as to the status of this plant. It is normally considered to be an alien although Stace (1991) states that it may be native. My first record is from waste ground near Carmunnock in 1985 and it was seen later in the same year in an allotment near Cluny Villas, in the vicinity of Victoria Park (P R Orr). Plants were seen on waste ground and adjacent roadside at Crown Street in 1988 and one plant at a track side in the Garden Festival site in 1991. In none of these sites has the plant persisted.

DISCUSSION

It is appreciated that it may be difficult to distinguish *G. endressii* from *G.* x *oxonianum*. Further, other hybrids may be similar to *G.* x *magnificum*. However the plants which I have recorded have "keyed out" to the taxa reported.

It is probable that plants in the majority of sites are the result of fly-tipping although some may be the result of natural dispersal from horticultural material. Those which are (or were) at the Garden Festival site have been bulldozed to their present sites, or again are the result of natural dispersal. The occurrences of *G. pyrenaicum* were the result of unintentional introduction.

Some of the records were made while recording for the "Flora of Glasgow" (Dickson 1984).

ACKNOWLEDGEMENTS

I am grateful to E.J.Clement and P.F.Yeo for help with identification and to K Watson for supplying records.

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COTONEASTERS CONTINUED

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INTRODUCTION

In 1992 we reported the records of the 13 taxa of cotoneaster known to us to occur in the Glasgow area of Lanarkshire (VC77) (Macpherson & Lindsay 1992). An update (Macpherson & Lindsay 1993) gave information about a further five species (one from V.C.76) and of the additions and losses of the original 13 taxa. This report was extended to include sites which are also within the Glasgow area but are in neighbouring vice-counties. These were mainly tetrad records made by others while recording for "The Changing Flora of Glasgow" (Dickson *et al* in preparation). As an aid to identification a drawing of a typical leaf was provided for each of the 18 plants.

In the intervening period we have discovered nine additional species and made further records of most of the taxa already recorded. We have also noted the losses. As one of the authors is the plant recorder for Lanarkshire, we have been active only in that vice-county and have, of course, been able to check only the various sites known to us. This account therefore, reverts to that of the original report and relates only to the VC77 part of the Glasgow area.

ADDITIONAL SPECIES

As before a typical leaf of each additional species is illustrated. The first sighting of eight of the additional species was a new VC record, and in most cases the first record for a much wider area.

Cotoneaster astrophoros (Fig 1)
A few small plants were seen on an abandoned railway viaduct at Dalmarnock in 1994. This is the first record of the plant occurring "in the wild" in the British Isles.

C. boisianus (Fig 2)
A single low arching plant was noted in 1995 in the long abandoned railway station at the south east corner of the Botanic Gardens.

C. dammeri (Fig 3)
In 1994 a relatively large prostrate plant was seen growing along and slightly over the breast wall of the River Clyde near Bell's Bridge. In the same year a further prostrate plant was noted on rubbly waste ground at the site of a derelict industrial estate at Dalmarnock. There is a previous Lanarkshire record for this plant. Scott (1976) reported that it had been persistent near Lanark for over 20 years and that there was then a patch over $13m^2$. In 1984 (after the death of the author) we assiduously searched the site given and concluded that *C. dammeri* was no longer present.

C. frigidus (Fig 4)
There has been difficulty in making a positive identification of this plant as it is one of the parents of *C.* x *watereri* (the other being *C. salicifolius*) and can be difficult to separate from this hybrid. Leaves of this taxon vary considerably from plant to plant depending on the relative influence of each parent and can even be very variable in the same plant. In addition to further foliage, flowers and fruits from a plant first seen in 1989 at the edge of a shrubby wood at Shieldhall have now been collected and the plant determined as C. frigidus. Similarly, a plant first seen in 1994 at the old Botanic Garden Station has been given the same identity.

C. hylmoei (Fig 5)
In 1995 a strong circular plant with many crowded branches bearing not only flowers but also fruit from the previous year was noted in rough grassland in an unused part of an industrial complex at Laigh Mains, East Kilbride. A week later a large seedling was seen on an abandoned industrial site in Cessnock. We are informed that these are the first reports from Great Britain, the only other record for the British Isles being from Co. Offaly, Ireland. It is interesting to note that our plants were identified by the international cotoneaster referee after whom the species has been named.

C. lacteus (Fig 6)
A single plant, noted for the first time in 1995, grows in the old Botanic Garden Station.

C. rehderi (Fig 7)
This plant has leaves shaped similarly to those of *C. bullatus* making identification difficult. However, it is only sparsely pubescent on the lower side of the leaf and the fruit is larger. A strong plant was identified from the edge of a wooded area in Eastfield, Rutherglen in 1995.

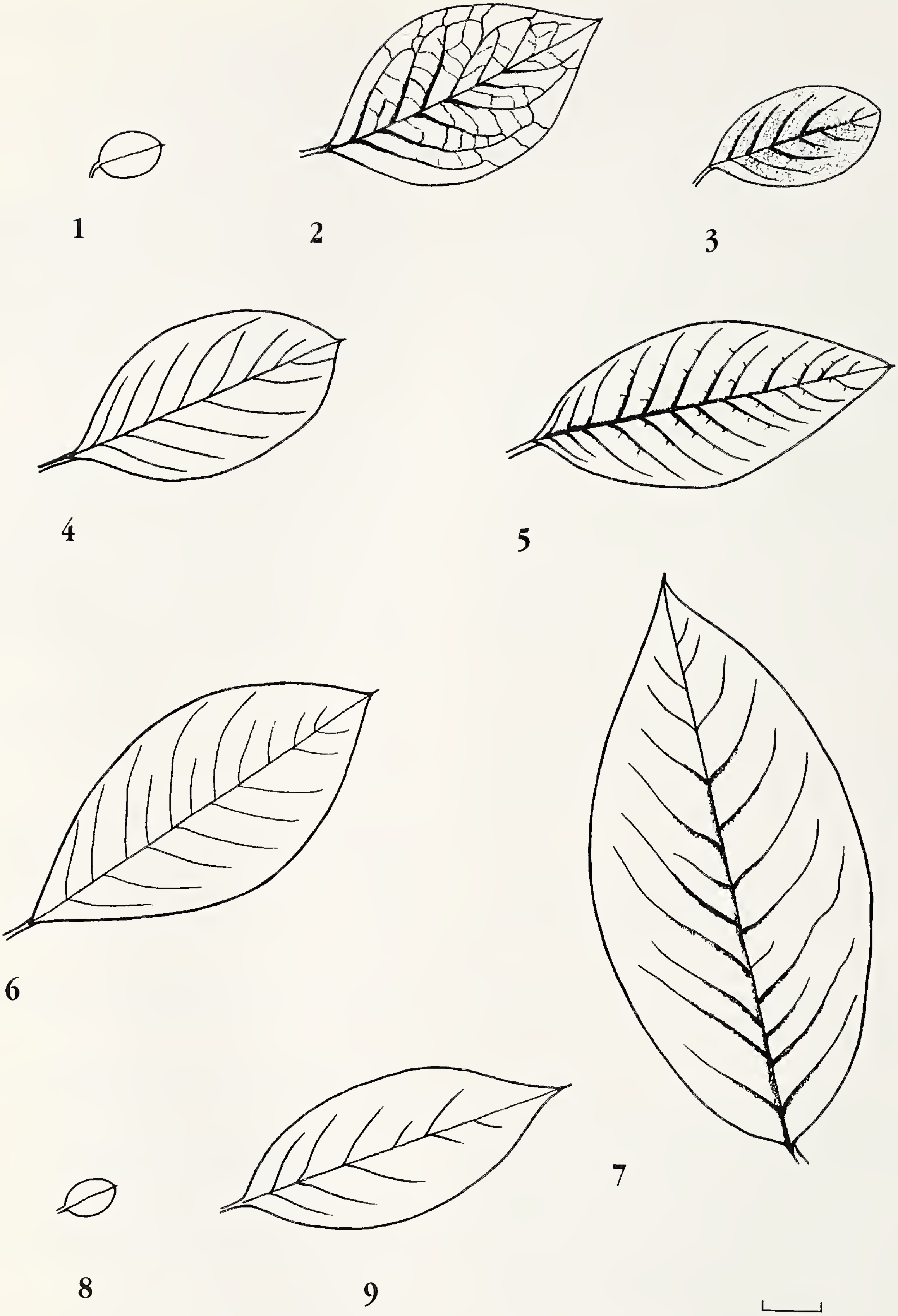
C. sherriffii (Fig 8)
In 1995 a small low-growing plant was seen on the abandoned railway viaduct at Dalmarnock.

C. villosulus (Fig 9)
A single, narrow upright plant 1.5m tall grows under a tree in a damp wood near Busby. It was first seen in 1993.

FURTHER RECORDS AND LOSSES OF TAXA PREVIOUSLY RECORDED

As indicated above, this account reverts to reporting the occurrences in VC77 only. Where there have been five or more records the actual sites have not been listed.

C. sp. ser *Bullati*
In 1994 a further plant was seen at the site of the 1988 Glasgow Garden Festival but in a different Ikm square from that previously reported and in the same year a record was made in Dalmarnock. The original site has been bulldozed leaving two extant sites in VC77.



Figures 1 - 8
Typical leaf drawings (see text for key)

C. bullatus
A further eight records have been made since the 1992 report with only one loss giving a present total of 17 sites.

C. conspicuus
An upright form was identified from grassy ground and around graves in the Necropolis in 1993 and a more conventional form on the viaduct at Dalmarnock in 1994. The Garden Festival site plants have been eradicated but it can still be found at Kingston leaving three present sites.

C. dielsianus
The old railway viaduct features again, a plant having been seen in 1994, bringing the present number of sites to three.

C. divaricatus
The 1986 Meadowside plant is still present and an additional site was found under trees at the edge of a side road in Rutherglen in 1993.

C. franchetii
Four further records have been made (Burnside, Dalmarnock, Kelvinside and West Rutherglen). With only one loss there are seven extant sites.

C. hjelmqvistii
One plant was seen between King's Park and Rutherglen in 1993 and two tiny seedlings (without a parent in sight) under shrubs in the Botanic Gardens in 1994. In 1995 a further plant was noted within the Botanic Gardens at the site of the old Railway Station, but in the same 1km square. Including the plants on the Clyde piles there are three extant sites in the Glasgow area.

C. horizontalis
Since the previous report we have made six new records. Of those previously recorded three have been lost leaving 12 present sites.

C. salicifolius
There have been five additions and one loss due to development, giving a present total of 11 sites.

C. simonsii
Sixteen further records and three losses bring the total of extant sites to 31.

C. sterianus
In 1995 seedlings were noted within a small shrubby wood near the South Rotunda. The plants at Cessnock are thriving and increasing in number, thus giving two extant sites.

C. x *suecicus*
In 1994 three new records were made: among stony ground at Kingston, at the edge of a wood in the grounds of the Southern General Hospital and on the abandoned viaduct at Dalmarnock. One of the two previous sites recorded, that at the Garden Festival site has been bulldozed, but it persists at Cessnock giving four present sites.

C. x *watereri*

There have been four additions since the last report: from an abandoned industrial complex at Dalmarnock in 1993, from the old station at the Botanic Gardens in 1994 and in two adjacent 1km squares on the banks of the River Kelvin on either side of Kelvin Way in 1995. The plants at the Garden Festival site have been lost leaving a total of seven localities.

There has been no change since the previous report to the status of *C. adpressus, C. atropurpureus, C. cashmiriensis* and *C. integrifolius.*

As before, the vast majority of the plants are on sites which indicate spread by bird droppings. Nowhere is this more obvious than along the length of the railway viaduct at Dalmarnock which ceased to be used in 1965, where some of the above cotoneasters and plants of other genera grow just adjacent to the edging walls, and at the long-abandoned station at the Botanic Garden where practically all the cotoneasters present are situated around the peripheral fence. It is interesting to note that cotoneasters are not a feature of the planting at the Botanic Gardens.

As reported previously, we consider *C. horizontalis* and *C. simonsii* to have been the cotoneasters most commonly planted in gardens in the West of Scotland and the latter remains the one most commonly found in the wild. However, other more attractive taxa are increasingly being planted. The number of *C. bullatus* sites has already overtaken those of *C. horizontalis* and it is anticipated that this will increase further, as will the dissemination of others, particularly *C. salicifolius* and *C.* x *watereri.*

Since 1984 we have recorded 26 cotoneaster taxa from that part of the Glasgow area which lies within V.C.77. Of these, only *C. adpressus* and *C. cashmiriensis* have become extinct, the first when the scrubby low bing complex on which it grew was cleared for development and the second as part of a tidy-up process in honour of a visit by The Princess Royal.

ACKNOWLEDGEMENTS

We are very grateful to Mrs J. Frier, Mr B. Hylmo and Mr J.R Palmer who among them made all the original and most of the subsequent identifications.

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LISMORE FLORA: FLOWERING PLANTS AND FERNS

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BACKGROUND AND SCOPE

The island of Lismore, part of the parish of Lismore and Appin and in the former administrative county of Argyll, forms a very small (0.6%) but valuable part of the Watsonian Vice-county Main Argyll, VC.98 (see Map - Figure 1).

Many habitats, resulting from the predominantly limestone geology, rich in plants and other groups such as Lepidoptera still survive. These are of great value not only in the context of the local vice-county but in a much wider, national, sense. Indeed the island has recently been designated an Environmentally Sensitive Area (ESA) while Bernera Island and the Lismore lochs had previously been notified as Sites of Special Scientific Interest (SSSI`s).

No attempt has previously been made to document the varied and valuable habitats and flora and the following paper draws attention to these and brings together available plant records in the form of a checklist.

In addition to Lismore and Bernera the small non-tidal islands of Creag Island, Eilean Droineach, Eilean Dubh, Eilean na Cloiche, Eilean nan Gamhna, Eilean Ramsay, Inn Island, Pladda Island and Sgeir nan Tom, for which some records are available (P. Wormell 1986/1988), have been included. No records are available for Eilean Loch Oscair and Eilean Musdile. Eilean na Caorach, which lies largely in quadrant 94 NW, has been excluded. All vascular plants known to occur in the wild are included and, because they are a particularly valuable feature of the island lochs and fens, the Charophytes (Stoneworts) are very briefly covered. Planted trees have been excluded except when naturally regenerated specimens have been found in the wild.

TOPOGRAPHY, GEOLOGY AND CLIMATE

Lismore lies at the mouth of Loch Linnhe, roughly midway between Lorn and Morven (Plate 1, upper); its south-west end is at the meeting point of this large sea loch with the Firth of Lorn and the Sound of Mull. The long axis of the island coincides with the midline of Loch Linnhe - SW/NE.

With a total length of 15.3 km (9.5 miles) and a maximum width of 2.4 km (1.5 miles) the land area of the main island is 2177 ha (5380 acres). On its west side, 4km (2.5 miles) from the south end, lies the botanically important tidal island of Bernera with an additional land area of 42 ha (105 acres).

Lismore is low lying and generally the ridges and shallow troughs coincide with its long axis. The highest point, 127m (415 ft.), is reached on the ridge of Barr Mor towards the south end of the island. The shallow troughs house Lismore's three main water bodies: Loch Fiart, Kilcheran Loch and Loch Balnagown. In addition Killean Loch is a quite extensive loch and fringing fen while elsewhere there are smaller areas of fen and swamp.

Because of its restricted width, catchments are limited and watercourses small and often slow-flowing. Springs and their associated flushes and runnels are frequent, particularly at the foot of raised beach cliffs. Where these springs are highly calcareous tufa deposits have formed.

A very important feature of the island is its raised beach backed by cliffs of varying height. These raised beaches and cliffs virtually encompass the island, including Bernera.

Due to its relatively sheltered position the island's shore line, for much of its length, is one of gently shelving limestone rocks with shingle beaches infrequent and sandy beaches absent. Only at Fennachrochan bay in the north and at Salen in the west, where there are fairly land-locked conditions, have quite extensive areas of silty shingle and associated saltmarsh been able to develop.

Geologically the island is composed almost entirely of metamorphosed limestone of the Dalradian series notable for its very low magnesia (MgC03) content. Basaltic intrusions in the form of dykes are frequent though generally small; larger ones occasionally occur as on the coast north-west of Loch Fiart at Grid ref. 799383. The influence of these dykes on the vegetation is discussed in the section on woodland. By contrast Eilean Dubh is composed of acid quartzite schist, while only 4.5km distant, across Loch Linnhe in VC.97, the Glensanda super-quarry is steadily devouring the Morven granite. Only at the north end of Lismore are there significant deposits of boulder clay and overlying acid peat. Elsewhere the limestone is close to the surface over large areas, often outcropping, and in valley bottoms deposits of fen peat have formed.

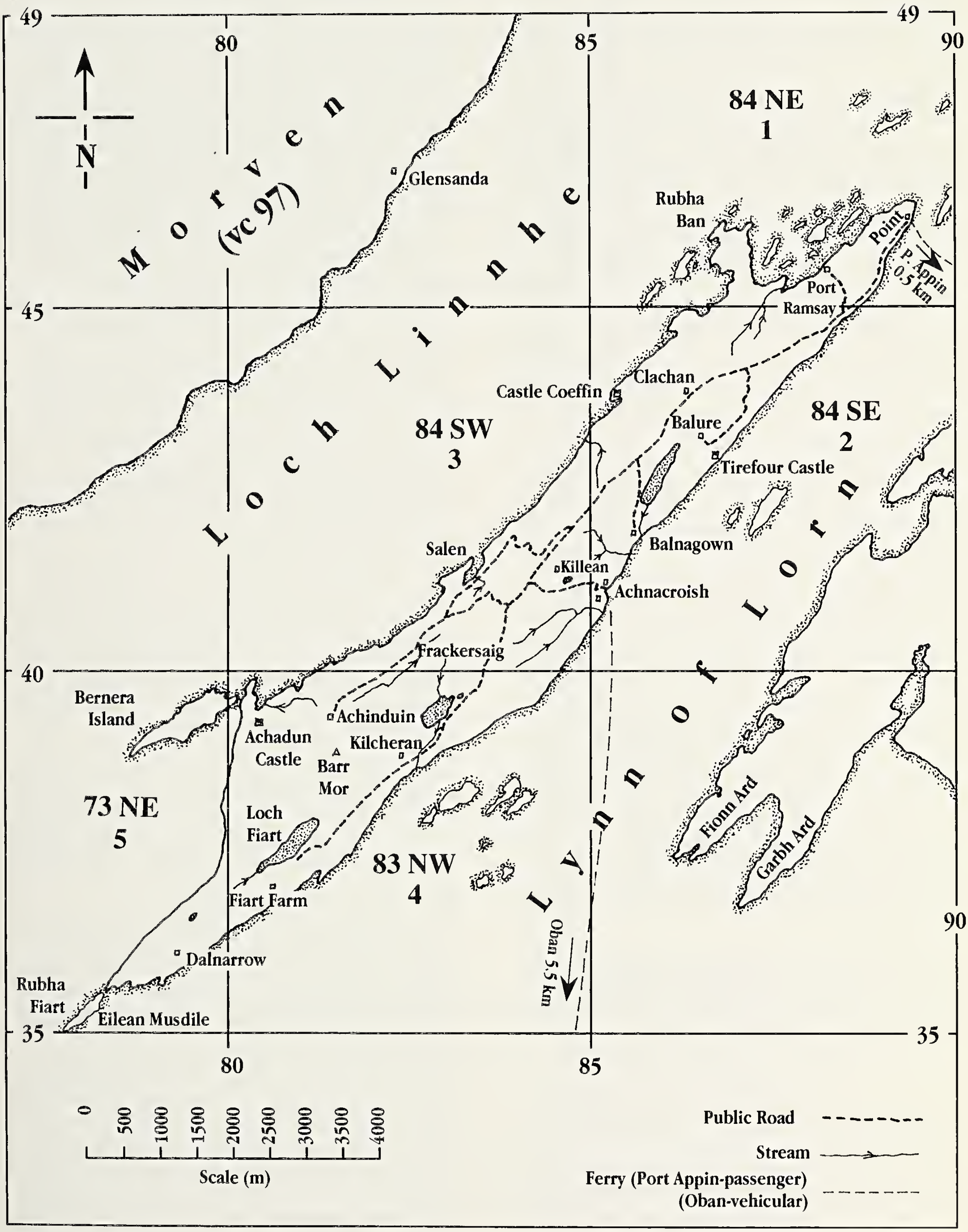
Being on the Atlantic coast and influenced by the Gulf Stream, the climate of Lismore could be described as equable. Annual rainfall at Frackersaig during the seven year period 1985-1991 averaged 1847mm (72.7 inches). Lismore is particularly exposed to the prevailing south-west winds which sweep up the Firth of Lorn, and similarly to the less frequent, but colder, north-easterlies blowing down Loch Linnhe.

HISTORICAL AND PRESENT DAY LAND USE

The name Lismore is generally thought to be derived from the Gaelic lios mór, the great garden, because of its particularly fertile calcium-rich soils. It has been suggested that prior to the sixth century the island was entirely covered by forest (Carmichael, 1948). Modern pollen analysis is highly desirable to reveal woodland history as it is probable that prehistoric people much influenced the vegetation. Certainly in the more recent past the island became, in the agricultural sense, a fertile place and by all accounts much corn was grown.

As far back as 1594, Sir Donald Munro, High Dean of the Isles, described the island as "commodious for nolt (cattle) and horses, but best for cornes" and he added that there grew upon it "the best beir (winter barley) in the Isles" (Carmichael, 1948). Lismore did not escape the effects of the Clearances which probably started to have their effect early

Figure 1 Lismore (Main Argyll, vc 98)



in the nineteenth century. "On the island of Lismore there was considerable evidence presented to the Napier Commission concerning clearances from the Kilcheran estate just before the famine (1846) .... tenants were pressed to convert their arable to pasture so that when the clearance was carried out the land was ready for the landlord's stock" (Turnock *et al.*, 1977).

Today there is very little arable land and the resulting loss in cornfield and other arable weeds must have been enormous (see section on miscellaneous habitats). Population peaked in 1831 when the census showed 303 houses, 317 families and a total of 1790 people. In 1947 the population was down to only 206 (estimated), and the 1991 census recorded just 140 permanent residents.Present day farming on Lismore is almost entirely devoted to the raising of sheep and cattle. Some hay is grown but mainly in the form of silage and many of the traditional hay meadows are now lost.

The first botanical observation on the island seems to have been made by Reverend John Lightfoot when, on 11th August 1772, he and his party "landed on the isle of Lismore to see a Danish fort" (Bowden, 1989). On this occasion Lightfoot noted "*Caucalis arvensis*... in cornfields. I observed it on the island of Lismore..." (Lightfoot, 1777).

Apart from references to the famed Bernera Yew the next botanical information is provided by Macvicar (1899). He must have visited the island prior to that year, perhaps on more than one occasion. His short paper suggests that, while much has probably changed little over the ensuing century, such "colonists" as *Chrysanthemum segetum, Euphorbia helioscopia, Lamium purpureum, Sinapis arvensis* and *Viola arvensis*, now rare plants, were even then much more frequent. G. West visited the three major Lismore Lochs, prior to 1905, as part of a more general survey of a number of Scottish lochs.

The next botanical visitors to supply records were W.A. Sledge and E.C. Wallace in 1949. It was they who first recorded *Juncus compressus* "west of Balnagown".

Since the 1960's the island has had much more frequent visits from a small number of botanists, notably A.A.P. Slack, A. McG. Stirling and P. Wormell. Even so, parts of the island were, apparently, only looked at superficially for it was not until c.1991 that the quite large population of *Dryas octopetala* was discovered near the south end of the island. In the same year *Melampyrum sylvaticum* was first noted, this time in the north-west.

Since then Alison Brooks has made some remarkable discoveries, particularly on Killean Farm. Unfortunately knowledge of these came too late to be included in the *Argyll Checklist* (Rothero & Thompson, 1994).

THE FLORA - AN OVERVIEW

No comparable areas of low-level limestone, largely free from masking drift deposits, occur in Main Argyll.

Free from industrial development, modern intensive agriculture and tourist developments, many valuable habitats have survived, and it is one of the purposes of this paper to draw attention to their presence in the hope that they will remain undamaged in the future.

The habitats of greatest value are the calcareous lochs and fens; streams; springs and flushes; unimproved limestone grassland; limestone outcrops and cliffs, particularly in the context of the raised beaches; and mixed broad-leaved scrub woodland.

Other habitats of lesser importance are miscellaneous wetlands; heaths; saltmarshes; arable and garden ground; roadsides; and disused quarries. All these will later be considered in some detail.

Much of the island consists of "improved" grassland, not considered above. These grasslands are species-poor, but transitional areas occur between these and unimproved grassland wherever physical barriers exist to the use of machinery or to the grazing of livestock, for example where limestone reaches the surface to break-up the grasslands, along the irregular margins of scrub, and at dangerous cliff-tops fenced-off to grazing animals. Before considering habitats in more detail it is worth pondering over some more general aspects of the island's flora.

No British Red Data Book species (those species restricted to 15 or fewer 10 kilometre squares in Britain) occur on Lismore.

Eight scarce plants (those species restricted to 16 - 100 10 kilometre squares in Britain) occur on Lismore: *Dryas octopetala, Hammarbya paludosa, Melampyrum sylvaticum, Orobanche alba, Potamogeton coloratus, P. filiformis, Potentilla neumanniana* and *Sorbus rupicola*.

Eight Main Argyll plants are apparently restricted to Lismore: *Anthemis arvensis, Fumaria officinalis, Papaver dubium, Polypodium cambricum, Potamogeton coloratus, P. filiformis, Saxifraga tridactylites,* and *Tragopogon porrifolius*.

Botanical visitors to Lismore are particularly impressed by the abundance of *Carex diandra* and *C. viridula* subsp. *brachyrrhyncha* in the drier parts of fens, and of *Helianthemum nummularium* in many places in limestone grassland and on rock outcrops. The latter plant probably grows nowhere else in the west of Scotland north of Ayrshire, though it occurs sparingly at Port Appin close to the north end of Lismore.

Other Main Argyll plants have their main populations on Lismore: *Arenaria serpyllifolia, Briza media, Centaurium erythraea, Clinopodium vulgare, Epilobium parviflorum, Geranium columbinum, Gymnadenia conopsea, Koeleria macrantha, Melampyrum sylvaticum, Myriophyllum spicatum, Potentilla neumanniana, Sagina nodosa, Sedum acre, Sorbus rupicola* and *Veronica anagallis-aquatica*.

Lismore plants which are essentially western in their distribution are: *Anagallis tenella, Hymenophyllum tunbrigenese, H. wilsonii, Hypericum androsaemum, H. elodes, Orobanche alba, Osmunda regalis, Pinguicula lusitanica, Schoenus nigricans, Scutellaria galericulata, S. minor* and *Sedum anglicum*.

Only four plants which are characteristically eastern in distribution occur on Lismore, and all are rare: *Fumaria officinalis, Lamium album, Thlaspi arvense* and *Urtica urens*.

Apart from Rock-rose a considerable number of Lismore plants are at or near the northern limit of their range in Britain: *Adoxa moschatellina, Alisma plantago-aquatica, Anthemis arvensis, Apium graveolens, Arum maculatum, Berula erecta, Briza media, Carex vesicaria, Ceterach officinarum, Chrysoplenium alternifolium, Clinopodium vulgare, Epipactis helleborine, Geranium columbinum, G. lucidum, G. pratense, Hypericum maculatum, H. perforatum, Juncus compressus, Leontodon hispidus, Lythrum salicaria, Moe-

hringia trinervia, Mycelis muralis, Polypodium cambricum, Potamogeton coloratus, P. lucens, Potentilla neumanniana, Salix purpurea, Saxifraga granulata, S. tridactylites, Solanum dulcamara, Taxus baccata, Tragopogon porrifolius, and *Veronica montana.*

Because of the calcareous conditions a number of plants, which are frequent or common in the more acid conditions on the mainland, appear to be absent on Lismore: *Carex laevigata, Cytisus scoparius, Empetrum nigrum, Huperzia selago, Lathyrus linifolius* subsp. *montanus, Lycopodium clavatum, Melampyrum pratense* and *Myriophyllum alterniflorum.*

Other fairly common plants of acid mainland sites are rare on Lismore: *Carex pallescens, Eriophorum vaginatum, Galium saxatile, Gymnocarpium dryopteris, Juncus squarrosus, Lobelia dortmanna* and *Veronica officinalis.*

Although usually associated with acid soils, *Calluna vulgaris* is common on Lismore but the limy soils and heavy grazing keep it suppressed and inconspicuous in many places.

Coastal species are rather poorly represented. *Bolboschoenus maritimus* and *Honckenya peploides* are both absent while *Tripleurospermum maritimum* is infrequent and *Silene uniflora* rare.

Several plants, tolerant of basic conditions, have not yet been found on Lismore but could well occur: *Ajuga pyramidalis, Anagallis minima, Carex disticha, Carlina vulgaris, Cephalanthera longifolia, Festuca gigantea, Milium effusum, Neottia nidus-avis, Pimpinella saxifraga* and *Ranunculus auricomus.*

Conifer plantations are fortunately small and few in number and self-sown conifers very rare. *Rhododendron ponticum* is absent and other introductions thankfully few. *Juncus tenuis* has apparently not yet reached the island, while *Epilobium brunnescens* is rare.

Fallopia japonica, noted in only three places, is unlikely to become invasive on the island's base-rich soils. A prudent approach would be to remove the plants now.

Apart from the decline in arable weeds there are very few other species which we know to have become diminished or lost. *Hypericum elodes* is the most intriguing. Macvicar (1899) described it as "rather common". Until recently it was thought to have become extinct but has now been refound - very sparingly at Killean Farm.

HABITATS

Lochs and Fens (Back cover, upper)

Darling and Boyd (1964) wrote: "The shallow limestone lochs of Lismore have the richest flora of any Highland lochs ...", using "highland" in its broadest sense. While the Lismore lochs do have a rich aquatic flora they are surpassed by some of the Herbridean lochs where the range of substrates is wider (Preston, C.D. pers. comm.).

The major Lismore lochs are Loch Balnagown (c. 1000m x max.200m), Kilcheran Loch (c.700m x max.250m) and Loch Fiart (c.1000m x max. 200m). All lie in shallow valleys at an elevation of 20 - 30 m above sea-level. Fringing fens occur at both ends of the first two lochs but at Loch Fiart this is restricted to the south end. *Phragmites australis* is the most conspicuous member of the fen community and in former times this was cut, at least at Loch Balnagown, "... for economic purposes" (West, 1905) - presumably for thatching.

TABLE 1

SPECIES	Loch Balnagown	Kilcheran Loch	Loch Fiart	Niche
Alisma plantago-aquatica	-	-	-	EA
Carex curta	-	+	+	SF
C. diandra	+	+	+	SF
C. nigra	+	+	+	SF
C. paniculata	+	+	-	SF
C. rostrata	+	+	+	SF
C. vesicaria	-	+	-	SF
C. viridula subsp. brachyrryncha	+	+	+	SF
Cladium mariscus	-	+	-	SF
Eleocharis palustris	+	+	+	EA
Equisetum fluviatile	+	+	+	EA
Glyceria fluitans	+	-	+	EA/FA
G. notata	-	+	+	EA
Hippuris vulgaris	+	+	+	EA
Littorella uniflora	+	+	+	SA
Menyanthes trifoliata	+	+	+	EA
Myriophyllym spicatum	+	+	+	SA/EA
Nuphar lutea	+	+	+	FA
Nymphaea alba	+	+	+	FA
Phragmites australis	+	+	+	RF
Polygonum amphibium (aquatic form)	+	-	-	FA
Potamogeton berchtoldii	+	+	+*	SA
P. coloratus	+	+	+	SA
P. filiformis	+	+	+	SA
P. lucens	-	-	+	SA
P. natans	+	+	+	FA
P. perfoliatus	-	+	+	SA
P. polygonifolius	-	+	-	EA/SA
P. praelongus	-	+	+	SA
Pontentilla palustris	+	+		FA/SF
Schoenoplectus lacustris	+	+	+	EA
Sparganium emersum	-	+	+	EA/FA
S. erectum	+	+	+	EA
Utricularia vulgaris agg.	+	+	+	SA

* = no recent records; EA = Emergent Aquatic; FA = Floating Aquatic; RF = Reed Fen; SA = Submerged Aquatic; SF = Sedge Fen. Note: some overlapping occurs between these categories.

Killean Loch, near Achnacroish, is much smaller than the above, but with its extensive fringing *Phragmites* fen, is another valuable site. So too is the even smaller loch between Loch Fiart and Dalnarrow. There is a species-rich fen, less calcareous than the above, below Argyll Cottage and fragments of fen occur in a few other places.

At Killean Loch, and noticeable even during the last four years, there has been considerable encroachment of *Phragmites* with consequent loss of open water area (A.M.L. Brooks, pers. comm.). At Loch Balnagown also the area of Reed fen is now more extensive than formerly (L.J.M. Stewart, pers. comm.).

The water of the three main lochs is notable for both its clarity and lime content. West (1905) remarks "... one may look over the side of a boat and see the bottom through twenty-five feet of water." He also quotes an analysis by W.E.

Tetlow in which suspended solids amounted to 191 parts per million of which 151 were calcium carbonate.

According to the *Statistical Account* of 1791-1799 (p.357) "The prodigious strata of marl, from ten to sixteen feet deep, in the bottom of all the lakes in Lismore, may be ranked among the curiosities of this parish".

Because of the lime rich water the lochs have an abundance of *Charophytes* (Stoneworts), usually heavily encrusted with lime.

Table 1, while not exhaustive, shows most of the aquatic and sedge fen species of higher plants.

This table indicates that Kilcheran Loch is the most species-rich, Loch Fiart almost as diverse, while Loch Balnagown has several species absent including four *Potamogeton* spp.

Potamogeton coloratus and *P. filiformis* occur nowhere else in VC 98, while *Cladium mariscus, Glyceria notata, Myriophyllum spicatum* and *Potamogeton lucens* are rare, or very rare, elsewhere in Main Argyll.

Carex limosa, absent from the three lochs, occurs only in the fen below Argyll Cottage. *C. aquatilis*, noted by West (1905), appears to have been lost.

Streams

Lime-rich streams are frequent but, draining from small catchments, are small and short in length. Only one, Allt a' Mhuilinn, bears a name on the 1:25,000 maps.

Streams are often slow-flowing and valuable habitats for aquatic, emergent and stream-side plants. Where they approach the coast they are usually faster flowing as they cut down through the raised beaches. Occasionally small ravines are the result as at Achnacroish and above Salen bay. Slower flowing sections are frequently fringed by areas of mire.

Potamogeton polygonifolius is a frequent aquatic of these slow-flowing sections while *P. coloratus* occasionally occurs as in the stream south-west of Achnacroish and in the outflow from Kilcheran Loch.

Emergent species which are more numerous and characteristic of these are *Glyceria fluitans, Mentha aquatica, Myosotis laxa* subsp. *caespitosa, Oenanthe crocata, Rorippa nasturtium-aquaticum* agg. and *Veronica anagallis-aquatica*, while *Hippuris vulgaris, Mimulus* x *robertsii* and *Sparganium erectum* occur occasionally.

The outflow stream from Loch Balnagown has *Apium nodiflorum* in plenty while the stream below Cameron Cottage has *Berula erecta*, the latter at its only known Lismore site. *Mentha* x *piperita* has established itself in the last-mentioned stream and also at Dalnarrow.

Characteristic stream-side species are *Caltha palustris, Epilobium parviflorum, Filipendula ulmaria, Geum rivale, Hypericum tetrapterum, Iris pseudacorus, Ranunculus acris* and *Senecio aquaticus*.

Several streams have populations of *Petasites hybridus* which seems to favour faster flowing and stony sections, often close to the sea.

Springs and Flushes

Springs occur most frequently along the base of coastal raised beach cliffs but also at the base of steep slopes, and in other places, inland. The flushes that they produce take a variety of forms.

In its simplest form a strong spring will produce a runnel flowing directly to the sea or a nearby stream. However, lateral seepage, creating a broad flush, often occurs unless the outlet is maintained as a ditch, as is frequently the case on well tended agricultural land.

More commonly, particularly along coasts, springs are small and close together creating large areas of seepage.

These large seepage areas have resulted in peat formation and in some areas, for example south of Sloc a' Mhuilinn, have become partially eroded creating vertical zoning of the vegetation. The uppermost areas are the least alkaline, or mildly acidic, and here such plants as *Carex echinata, C. panicea, Dactylorhiza maculata subsp. ericetorum, Drosera rotundifolia, Eriophorum angustifolium, Narthecium ossifragum, Pedicularis sylvatica, Pinguicula vulgaris* and, more rarely, *Platanthera bifolia* occur. The faces of the eroded peat are the places to look for the elusive *Pinguicula lusitanica*.

At lower levels of the eroded peat conditions are much more calcareous and *Schoenus nigricans* can be dominant. A wealth of other species occur in these base-rich flushes: *Anagallis tenella* (rarely), *Carex dioica* (occasionally), *C. hostiana, C. pulicaris, C. viridula* subsp. *branchyrryncha, Centaurium erythraea* (in drier places), *Dactylorhiza incarnata, D. purpurella, Eleocharis quinqueflora, Eriophorum latifolium, Parnassia palustris, Sagina nodosa, Samolus valerandi, Saxifraga aizoides* (in stony and rocky places), *Selaginella selaginoides* and *Triglochin palustre* to name some of the more interesting.

Where the springs are strong, and well defined runnels result, *Rorippa nasturtium-aquaticum* agg. and *Veronica beccabunga* are often plentiful and *Stellaria uliginosa* also frequently occurs.

In hollows and flatter areas flushes will merge with areas of wet grassland or marsh where such additional species as *Caltha palustris, Epilobium palustre, E. parviflorum, Hydrocotyle vulgaris, Lychnis flos-cuculi, Pedicularis palustris and Ranunculus flammula* are likely to be found.

Limestone Grassland (Unimproved) (Plate 1, lower)

These grasslands have survived in areas where machine access is difficult or impossible, where cultivation and use of artificial fertilisers has not taken place, and where grazing is less intense.

They include grassland pockets among outcropping limestone; open areas on the edge of scrub woodland; areas fenced-off to grazing animals at the top of cliffs, around quarries and in a few other places; steep slopes at the base of cliffs, etc.. In a few cases sites may have survived as a result of sympathetic land-management in more recent times. Some areas of particularly valuable grassland have been identified and are being managed to conserve their botanical interest.

Many such grassland areas still survive but are perhaps most frequent in the south. Much of Bernera Island is a splendid example of this type of habitat. A tidal island of only 42 ha it has in the past enjoyed a sympathetic grazing regime while the terrain is too rugged for machine access. Nearly 250 vascular plants, including critical groups, have so far been recorded on this small island. Most of the Lismore grassland species mentioned below also occur on Bernera. Characteristic of dry grasslands, and often plentiful, are *Achillea millefolium, Campanula rotundifolia, Galium* *verum, Helianthemum nummularium, Linum catharticum, Lotus corniculatus, Luzula campestris, Pilosella officinarum, Plantago lanceolata, Potentilla erecta, Rhinanthus minor* and *Thymus polytrichus* subsp. *britannicus*.

Less frequent, but locally plentiful, are *Antennaria dioica, Anthyllis vulneraria, Carex caryophyllea, Daucus carota, Helictotrichon pubescens, Koeleria macrantha, Plantago maritima* and *Polygala vulgaris*.

Smaller, and more scattered, populations of *Centaurium erythraea, Galium boreale, Gentianella campestris, Potentilla neumanniana* and *Ranunculus bulbosus* occur, while *Dryas octopetala* is restricted to three small areas at the south end of Lismore and a tiny population on Bernera.

Common plants of damper grasslands are *Bellis perennis, Carex ovalis, Centaurea nigra, Conopodium majus, Cynosurus cristatus, Euphrasis officinals sensu lato, Lathyrus pratensis, Prunella vulgaris, Ranunculus acris, R. ficaria, R. repens, Rumex acetosa, Succisa pratensis and Trifolium pratense. Briza media* and *Salix repens* are locally plentiful in both dry and damp grassland.

Damp grasslands are also a rich habitat for orchids *Coeloglossum viride* (rare), *Dactylorhiza fuchsii, D. maculata subsp. ericetorum, Gymnadenia conopsea* (all three locally plentiful), *Listera ovata* (occasional) and *Orchis mascula* (frequent). Recently a tiny population of *Pseudorchis albida*, an orchid normally associated with more upland areas, has been found in unimproved grassland at Killean Farm.

Limestone Outcrops and Cliffs

Limestone outcrops and small crags occur inland over the whole of Lismore. Coastal raised beach cliffs virtually encompass the island and are generally higher and more impressive than inland crags. Steep slopes at the base of these crags and cliffs are frequently colonised by scrub woodland.

Rock detritus is also sometimes plentiful at the base of cliffs as below Druim Mor in the south-west. To some extent this provides an extension of the cliff-ledge habitats above. Soil pockets on large boulders are particularly favoured by *Arenaria serpyllifolia, Geranium lucidum, Saxifraga tridactylites* and, rarely, *Valerianella locusta*.

Sheltered recesses amoung the detritus provide homes for plants more commonly associated with woodland such as *Adoxa moschatellina, Allium ursinum, Mercurialis perennis* and *Circaea* x *intermedia*.

Drier limestone outcrops and cliff ledges are home to numerous species many of which also grow in drier limestone grassland. These include *Anthyllis vulneraria, Campanula rotundifolia, Centaurium erythraea, Dryas octopetala, Galium boreale, G. verum, Gentianella campestris, Geranium columbinum, G. lucidum, G. molle, Helianthemum nummularium, Koeleria cristata, Orchis mascula, Polygala vulgaris, Potentilla neumanniana, Saxifraga tridactylites, Sedum acre, S. anglicum* and *Thymus polytrichus* subsp. *britannicus*.

Cliffs along the east coast receive more sun than those in the west. For this reason they are drier and there is less development of scrub woodland than in the west, factors which have a considerable influence on plant distribution.

Ledges of the higher coastal cliffs are often inaccessible to grazing animals and are thus home to some of the island's most interesting plants.

Only two plants are restricted to the eastern cliffs, namely *Clinopodium vulgare* and *Polypodium cambricum* though the former does extend round the north coast to Glas Dhruim. Several species appear to be confined to the western cliffs: *Hymenophyllum wilsonii* (also very locally inland), *Melica nutans, Populus tremula, Sedum rosea, Sorbus rupicola, Taxus baccata, Thalictrum minus* (also at one inland site) and *Vicia sylvatica*.

Plants which occur on both eastern and western cliffs, but apparently rare or absent inland, include *Asplenium marinum, Cotoneaster integrifolius, Eupatorium cannabinum, Lapsana communis, Prunus avium, Rosa pimpinellifolia*, and *Sonchus asper*.

The many species which occur on both coastal and inland crags include *Asplenium adiantum-nigrum, A. ruta-muraria, A. trichomanes, Cystopteris fragilis, Hieracium spp.* (particularly on coasts), *Hypericum androsaemum, Plantago maritima, Phyllitis scolopendrium, Polystichum aculeatum, Rubus saxatilis, Solidago virgaurea* and *Ulmus glabra*.

Occasionally lime-rich water seeps plentifully down coastal cliff-faces with resultant tufa formation. *Schoenus nigricans* can be plentiful in such places "cascading" down the cliff to the flatter ground below. Cliff ledges in such situations are often colonised by large stands of *Eupatorium cannabinum*.

Mixed Broad-leaved Scrub Woodland

Climax vegetation of temperate broad-leaved woodland must once have covered all of Lismore except on the most skeletal soils of exposed ridges and in very wet valleys. Historical evidence suggests that this was indeed the case.

Remnants of this former woodland are now restricted to (a) West Coast. Narrow bands along the base of raised beach cliffs and other west-facing scarps from Glas Dhruim to Castle Coeffin; above Salen bay; Frackersaig; north of Bagh Clach an Dobhrain. (b) East coast. Below raised beach cliffs for a limited distance south of Port Kilcheran. (c) Inland. Some rocky scarps and knolls between Kilcheran and Frackersaig.

There is no woodland on the east coast south of (b) above, or north of it to Achnacroish. North of the last place there are woodland fragments but they are much influenced by man with Sycamore, and some Beech, and usually a species-poor ground flora.

There is some evidence that in recent times woodland cover was even more limited than it is today and that some natural recolonisation of denuded sites has occurred during the last 50 to 100 years. This could be supported by some woodland areas being rather species-poor suggesting they are of more recent origin.

Planting of native broad-leaves has recently been undertaken below the cliffs south of Salen and further similar projects would enhance the island's tree cover.

A wide range of woodland species occur with composition dependent on nature of soil, aspect, moisture, grazing pressure etc..

The Ash-Hazel wood at Port nan Leadaig, on the coast near Frackersaig, is fairly typical of this type of wood on a lime-rich soil and in an open situation. On its fringes there is some Blackthorn and Raspberry scrub and within *Allium ursinum* is abundant and *Mercurialis perennis* plentiful. *Anem-*

one nemorosa, Chrysoplenium oppositifolium, Conopodium majus, Crataegus monogyna, Crepis paludosa, Deschampsia cespitosa, Filipendula ulmaria, and *Primula vulgaris* are frequent species while *Circaea* x *intermedia, Geranium robertianum, Geum rivale, Lysimachia nemorum, Oxalis acetosella, Ranunculus ficaria, R. repens* and *Sorbus aucuparia* occasional.

In more shaded woodland, ferns such as *Athyrium filix-femina, Drypoteris affinis, D. dilatata* and *D. filix-mas* become more prevalent. This is particularly so in parts of the north-west and inland where volcanic intrusions have resulted in the formation of acid soils. Parts of the woodland south of Port na Moralachd are a good example. Here Birch and Rowan are a more important element and *Luzula sylvatica* can be plentiful while there are good populations of *Blechnum spicant, Hymenophyllum wilsonii, Luzula pilosa, Phegopteris connectilis* and *Vaccinium myrtillus.* These species also occur in part of the woodland west of Kilcheran Loch and here *Gymnocarpium dryipteris* and *Hymenophyllum tunbrigense* occur very sparingly.

Melampyrum sylvaticum, only recently discovered, shows a preference for Hazel dominated woodland on steep, often rocky, slopes. Elsewhere in Britain it often occurs at higher elevations, usually under Birch, and often associated with *Melampyrum pratense* which does not appear to grow on Lismore. Four orchids occur in these woodlands: *Dactylorhiza fuchsii* - in moist open areas, *Epipactis helleborine* - very rare in the north-west, *Listera ovata* - frequent, and *Orchis mascula* - frequent.

Four other plants are rare or local: *Adoxa moschatellina* - local, *Chrysoplenium alternifolium* - very scarce in north-west, *Moehringia trinervia* - very scarce, and *Pyrola minor* - only one plant.

Many other species, not mentioned above are common or frequent and can be found in the Checklist.

Few other tree species occur in these woodlands.

Fortunately Sycamore is still infrequent in the best woodland remnants as already defined; Alder is very local on wet woodland fringes, as at Castle Coeffin; Elder occurs on the north side of Glas Dhruim and very occasionally elsewhere; Gean is very local; Goat Willow frequent; Sessile and Hybrid Oak both rare; Wych Elm occasional in damp rocky places.

Miscellaneous

Miscellaneous wetlands: scattered wet areas occur which are inappropriate to include under fens or flushes. One such area lies south-west of Clachan and is fenced-off to livestock. Now modified by drainage it was presumably a small fen. It is now dominated by *Carex rostrata* with scattered bushes of *Salix cinerea* and *S.* x *rubra*. This is one of only three sites for *Carex curta* but overall it is species-poor.

South of the Port Ramsay road lies an area of *Juncus effusus/acutiflorus - Galium palustre* rush-pasture which is one of rather few sites for *Viola palustris*.

A similar area occurs south of the ruined Fiart Farm. Here there are scattered hummocks with *Drosera rotundifolia* and in the lowest lying areas, where drainage has at one time been attempted, bands of *Carex rostrata* swamp have developed.

Other areas of rush pasture occur particularly in the southern half of the island.

Heath: the *Dryas* community of Druim Mor is the same as that defined in Rodwell as *Dryas octopetala - Carex flacca* heath. However it is there included with calcicolous grassland and the same approach has been adopted here.

Calluna dominated heath is rarely found on Lismore but on the ungrazed cliff-top W.N.W. of Baleveolan there is a sizeable area of rank heather. Other species occurring with it are *Anemone nemorosa, Betula pubescens, Corylus avellana, Filipendula ulmaria, Luzula sylvatica* (locally plentiful), *Orchis mascula, Primula vulgaris, Salix aurita* and *Vaccinium myrtillus.* Communities similar to this occur in places on the scarp north of Castle Coeffin.

There is some development of heath on the south-east side of Loch Fiart, probably the result of acid soils being able to form over hard igneous intrusions.

Erica cinerea is occasionally quite plentiful over very limited areas in dry and exposed situations, often at the top of raised beach cliffs, mainly at the north and south ends of the island.

Examples of wet heath are infrequent. On the north side of the Port Ramsay road is a small and somewhat modified example of *Scirpus (Trichophorum) cespitosus - Erica tetralix* wet heath. Both these plants are rare on Lismore as are *Eriophorum vaginatum* and *Juncus squarrosus* which also occur.

East of Fiart Farm is another area of wet heath but modification by drainage may have resulted in the disappearance of all four species mentioned above.

Saltmarsh: the two principal examples are in the Port Ramsay-Fennachrochan area and at Salen. Small fragments occur occasionally elsewhere. Floristically they are poor with the most notable species being *Blysmus rufus, Carex extensa, Oenanthe lachenalii* and *Salicornia* sp. Commoner species are *Armeria maritima, Aster tripolium, Carex distans, Juncus gerardii, Plantago maritima, Spergularia media* and *Triglochin maritimum.*

Arable and Garden ground: prior to 1990 there were few records of arable weeds which at one time, when there was widespread cultivation, must have been a feature of the island's fields of corn and other crops.

During the early 1990's a small area at Killean Farm was ploughed, after an interval of over thirty years, to establish a native tree nursery. Alison Brooks reports that the annual array of flowers has been a constant surprise as seeds which must be capable of dormancy over long periods, come to the surface and germinate.

The list of species is remarkable with several new to Main Argyll, recorded for the first time in many years, or rare in the vice-county. These are: *Anagallis arvensis, Anthemis arvensis, Avena fatua, Chenopodium rubrum, Chrysanthemum segetum, Euphorbia helioscopia, E. peplus, Fumaria muralis, F. officinalis, Galeopsis speciosa, Lamium album, L. confertum, L. hybridum, Papaver dubium, Potentilla reptans, Silene latifolia* subsp. *alba, Thlaspi arvense, Tragopogon porrifolius, Urtica urens, Veronica agrestis, Vicia sativa subsp. sativa, Viola arvensis* and *V. tricolor* subsp. tricolor.

As might be expected the variety of these weeds has declined as the seed 'bank' becomes diminished and most are likely to disappear altogether as the rampant Corn Spurrey, Hemp-nettle and Redshank take-over. *Tragopogon* and *Vicia* *sativa* have probably already been lost and several others were not seen in 1995.

The arable field is uncooperative - a quadrant boundary runs through its middle!

Roadsides: a range of habitats occur here from unimproved limestone grassland, with for example *Briza media* and *Gymnadenia conopsea*, through rough grassland and scrub, to sluggish ditches with *Mimulus* x *robertsii* and *Rorippa nasturtium-aquaticum* agg. There is even saltmarsh at the edge of the rough public road round Salen bay.

A roadside retaining-wall is the only island site for *Ceterach officinarum* and the small colony of *Arum maculatum* is among scrub at the roadside.

Roadsides are quite frequently habitats for introduced species which become established as a result of the tipping of garden waste. *Claytonia sibirica, Crocosmia* x *crocosmiiflora, Lysimachia punctata* and *Veronica filiformis* are examples.

Disused quarries: limestone was formerly quarried on Lismore and exported. The quarry at Salen was a particularly large one with smaller ones at Port Kilcheran, Port na Moralachd and Port Ramsay. Production ceased some sixty years ago. The long abandoned workings are now, in effect, limestone outcrops and cliffs. At Salen however, the particularly high and steep faces are still unstable but neverthelsss they support good Hawkweed colonies.

Old buildings at the quarries make a useful habitat for a number of plants, particularly the ferns *Asplenium ruta-muraria, A. trichomanes, Cystopteris fragilis* and *Phyllitis scolopendrium*. Other plants which have taken advantage of the old buildings are *Arabis hirsuta* and *Erinus alpinus* (at Port Kilcheran) and *Cotoneaster integrifolius* (at Salen).

CHECKLIST

Botanical records for Main Argyll (VC 98) are kept on a quadrant basis (5 x 5 km. squares) and this practice has been continued in the following checklist.

Five quadrants are involved but for simplicity these have been identified by numbers as follows: NM84NE = 1; NM84SE = 2; NM84SW = 3; NM83NW = 4; NM73NE = 5. See also the map (Figure 1). For each species a brief description of habitat is given followed by an indication of the plant's distribution and frequency. For plants likely to be seen on any outing (at the appropriate time of year) the fairly self-explanatory terms common, frequent and occasional are used. For species described as rare some indication is usually given of their locations. Very rare indicates that the plant is presently known at one location only. Quadrant distribution (see above) is also shown.

For the purposes of the proposed new *Atlas of the British Flora* records made prior to 1987 are to be distinguised from those made afterwards. This practise is followed here.

For records made after 1986 usually no authority is given. For earlier records the authority and date, when known, are shown. A list of the people who have contributed to post 1986 recording on Lismore is given at the end of these introductory notes.

Introductions which are known to occur at three or fewer sites only are shown in small print. So too are scarce arable weeds and one or two other species which did not appear in 1995. Records made prior to 1900, extinctions and probable errors are shown in square brackets and small print.

Of the small non-tidal islands which fall within the scope of this paper only Eilean na Cloiche has been visited by the writer, and then only briefly. Records for any of the other small islands are from lists supplied by P. Wormell on behalf of the former Nature Conservancy Council for Scotland, now Scottish Natural Heritage.

Nomenclature and systematic order follows Kent (1992) and English names are from Dony, Jury and Perring (1986). In a very few cases, where a plant is not listed in the latter work, the English name is from Stace (1991).

Contributors (post 1986): Pat Batty, Alison M.L. Brooks (Killean Farm); A Campbell, P. Cashman (S.N.H.); Dr J.H. Dickson; Dr Marion Hughes (S.N.H.); Dr H. Lang; R Pollitt (S.N.H.); Dr C.D. Preston (B.R.C.); G P Rothero; A A P Slack; Edna W. Stewart; Lily J.M. Stewart; N.F. Stewart; A.McG. Stirling; B.H. Thompson; Anna E. White; K. White.

Abbreviations and Symbols

*	not native in British Isles
+	not native in Lismore
agg.	aggregate
c.	circa
conf.	confirmed
det.	determined
et al.	and others
ibid.	in the same place
ha	hectares
km	kilometres
pers. comm.	personal communication
Proc.	Proceedings
sensu lato	in the broad, or former sense
sensu stricto	in the strict, or narrow sense
sp(p)	species (plural)
subsp.(p)	subspecies (plural)
teste	on the testimony
var.	variety
VC	vice-county
VC97	Westerness
VC98	Main Argyll
Wats.	Watsonia
AAPS	A.A.P.Slack
AMcGS	A. McG. Stirling
AMLB	Alison M.L. Brooks
BBC	British Broadcasting Corporation
BHT	B.H. Thompson
BRC	Biological Records Centre
BSBI	Botanical Society of the British Isles
CDP	C.D. Preston
DJMcC	D.J. McCosh
HMSO	Her Majesty`s Stationery Office
ITE	Institute of Terrestrial Ecology
JNCC	Joint Nature Conservation Committee
NFS	N.F. Stewart
SNH	Scottish Natural Heritage

Key to layout of Checklist

Prominent capitals = Latin family names. For each species, the top line gives Latin name, common name, occurrence and quadrant distribution. Below are notes on habitat and any special comments on distribution.

SELAGINELLACEAE

Selaginella selaginoides Lesser Clubmoss Frequent 1-5
Flushes and wet ledges.

EQUISETACEAE

Equisetum fluviatile Water Horsetail Frequent 1-5
Shallow water of loch margins and wet ditches.

E. fluviatile x *E.arvense* = *E.* x *litorale* Shore Horsetail 3
Bog below Argyll Cottage.

E.arvense Field Horsetail Frequent 1-5
Roadsides, field margins and garden ground

E. sylvaticum Wood Horsetail
On AAPS list. No other records.

E.palustre Marsh Horsetail Occasional 1-5
Marshes and flushes.

OPHIOGLOSSACEAE

Ophioglossum vulgatum Adder`s-tongue Rare 1, 4
Scarce on tidal island off Port Ramsay and in woodland west of Kilcheran Loch

Botrychium lunaria Moonwort Very rare 3
Unimproved limestone grassland. Killean Farm. Probably elsewhere but overlooked.

OSMUNDACEAE

Osmunda regalis Royal Fern Very rare 3
Boggy ground. Killean Farm. Only three plants remain from what, apparently, was a large stand prior to disturbance for tree planting. Steps are being taken to reinstate the site to encourage this beautiful fern to thrive again.

HYMENOPHYLLACEAE

Hymenophyllum tunbrigense Tonbridge Filmy-fern Veryrare 4
Sparingly in woodland west of Kilcheran Loch.

H. wilsonii Wilson`s Filmy-fern Occasional 1-5
On shaded rocks and tree bases. Probably absent on the dry east coast.

POLYPODIACEAE

Polypodium vulgare agg. Polypody Common 1-5
On trees rocks and walls.

P.vulgare Polypody 2-5
Recorded from all quadrants except 1. Distribution not yet clearly understood.

P. interjectum Intermediate Polypody 1-5
Probably the commonest of the segregates.

P. cambricum Southern Polypody Rare 3-4
On raised beach cliffs. Known at three sites only between Achnacroish and Port Kilcheran. First found by AMcGS (1972) and two further sites located by AMcGS and BHT (1994). These are the most northerly sites in Britain.

DENNSTAEDTIACEAE

Pteridium aquilinum Bracken Common 1-5
Well drained soils. Common but much less vigorous on the well grazed limestone soils of Lismore than on more acid mainland soils.

THELYPTERIDACEAE

Phegopteris connectilis Beech Fern Rather rare 2-4
In woodland and other shady places where more acid soils have been able to develop. Mainly in the west.

Oreopteris limbosperma Lemon-scented Fern 1-5
Damp grassland where more acid soils have developed. Occasional in the south of the island, rather rare elsewhere.

ASPLENIACEAE

Phyllitis scolopendrium Hart's-tongue Common 1-5
Limestone rocks and walls, particularly in shady situations.

Asplenium adiantum-nigrum Black Spleenwort Common 1-5
Limestone rocks, walls and banks.

A. marinum Sea Spleenwort Local 1-5
Fissures of raised beach cliffs and coastal rocks.The best populations are in the south-west.

A. trichomanes Maidenhair Spleenwort Common 1-5
Rocks and walls. The sub-species on Lismore have not been investigated but all, or most, will almost certainly be referable to subsp. *quadrivalens.*

A. ruta-muraria Wall-rue Locally common 1-5
Fissures of limestone rocks and walls.

Ceterach officinarum Rustyback Very rare 2
Unlocalised, BSBI field meeting 1963 (*Proc. BSBI* 6, 194). Roadside wall at Achuaran where it was noted by AAPS in 1989. The population here has since declined and only three plants could be found in 1994.

WOODSIACEAE

Athyrium filix-femina Lady-fern Common 1-5
Woodland and damp banks.

Gymnocarpium dryopteris Oak Fern Very rare 4
Shady woodland on more acid soils. Frackersaig

Cystopteris fragilis Brittle Bladder-fern Common 1-5
Damp crevices of limestone rocks and walls.

DRYOPTERIDACEAE

Polystichum setiferum Soft Shield-fern Very rare 1
Foot of wooded roadside bank at Point.

P. aculeatum Hard Shield-fern Occasional 1-5
Shaded places on raised beach cliffs and in woodland.

*Dryopteris filix-mas*Male-fern Occasional 1-5
Woodland and other shady places.

D. affinis Scaly Male-fern Common 1-5
Woodland and rocky banks. Tolerant of much more open habitats than *D. filix-mas.* The segregates have not been investigated.

D. dilatata Broad Buckler-fern Frequent 1-5
Woodland and other shady places.

BLECHNACEAE

Blechnum spicant Hard Fern Local 1-5
Woodland and rocky banks where more acid soils have developed. Mainly in the west and not seen on the east coast.

PINACEAE

**Picea sitchensis* Sitka Spruce 2
A single self sown tree was seen in quadrant 2. Fortunately the tree is rarely planted on the island.

CUPRESSACEAE

Juniperus communis Juniper On AAPS list. No other records.

TAXACEAE

Taxus baccata Yew Rare 5
Two trees grow close together on a cliff on the north-east side of Bernera and to the south there are wind-blasted trees high up on a raised beach cliff on the west coast of Lismore itself. There is conjecture as to whether one of the two Yews on Bernera, inaccessible without a rope and machete!, has sprouted from the stump of the legendary tree cut down nearly 200 years ago (Dickson, 1994). Legend has it that St. Columba conducted services under this same tree (Carmichael, 1948) so at the time of its demise it must have been at least 1,200 years old! Nevertheless some doubt remains about the native status of Argyll Yews since trees may have been in cultivation many centuries ago to satisfy demand for its valuable timber (Dickson, 1994).

NYMPHAEACEAE

Nymphaea alba White Water-lily Local 2,4
Loch Balnagown, Kilcheran Loch and Loch Fiart.

Nuphar lutea Yellow Water-lily Local 2,4
Loch Balnagown, Kilcheran Loch and Loch Fiart.

RANUNCULACEAE

Caltha palustris Marsh-marigold Common 1-5
Marshes, ditches and loch-sides.

Trollius europaeus Globeflower 2-4
Wet meadows and marshy ground. Rare and populations small. Killean Farm and north of Port Kilcheran.

Anemone nemorosa Wood Anemone Common 1-5
Dry banks, usually in woodland.

Ranunculus acris Meadow Buttercup Common 1-5
Damp grassland.

R. repens Creeping Buttercup Common 1-5
Damp places.

R. bulbosus Bulbous Buttercup 1-2,4-5
Dry calcareous grassland. Probably frequent but easily overlooked except when in flower in late spring and early summer. The only record for area 5 is from Bernera (AAPS& AMcGS, 1966).

R. flammula subsp *flammula* Lesser Spearwort Common 1-5
Marshes and ditches.

R. ficaria subsp. *ficaria* Lesser Celandine
Common and often abundant 1-5
Damp pastures and woodland margins.

R. hederaceus Ivy-leaved Crowfoot Occasional 2,4-5
Muddy ground where inundation is frequent, for example at field gates.

R. trichophyllus Thread-leaved Water-crowfoot Rare 1,[4],5
Slow-flowing streams. Fennachrochan (AAPS c.1985); [Stream at Loch Fiart, Macvicar 1899 - as *R. drouetii]*; stream north of Dalnarrow (C.D. Preston, 1990).

Thalictrum minus Lesser Meadow-rue 1,3,5
On and below raised beach cliffs on the west coast from Glas Dhruim in the north to Druim Mor in the south. Inland at Killean Farm. Local, plentiful in a few places.

PAPAVERACEAE

Papaver dubium Long-headed Poppy 2-3
Arable ground, Killean Farm. When the arable field was first ploughed three years ago some 40 plants appeared. They then declined and none were seen in 1995.

+*Meconopsis cambrica* Welsh Poppy Very rare 1
Bushy ground on the north side of Port Ramsay

FUMARIACEAE

Fumaria muralis Common Ramping-fumitory Very rare 2-3
Arable ground. Killean Farm. None seen in 1995.

F. officinalis Common Fumitory Very rare 2-3
Arable ground. Killean Farm. (Formerly quite common on the edges of arable fields: L.J.M. Stewart pers, comm.) Both these Fumitories occur, somewhat unpredictably, in an arable field and vegetable plot. The sub-specific status of each needs to be determined.

ULMACEAE

Ulmus glabra Wych Elm Occasional 1-5
Raised beach cliffs and rocky woodland.

URTICACEAE

Urtica dioica Common Nettle Common 1-5
Most frequent in woodland and scrub at foot of raised beach cliffs; also about farms and other habitations.

U. urens Small Nettle Very rare 3
Arable ground. Killean Farm. Not seen in 1995.

MYRICACEAE

Myrica gale Bog-myrtle Rare 1,4
Boggy ground. Near Port na Moralachd; Brynalen; near Kilcheran Loch.

FAGACEAE

+*Fagus sylvatica* Beech 2-4
Planted in several places on the east side of the island (e.g. Kilcheran) and a few small self-sown trees occur in these areas.

Quercus petraea Sessile Oak Rare 2-3, (5)
Raised beach cliffs and possibly elsewhere. North of Castle Coeffin and a single tree south of Achnacroish. (Leaves were found below the Druim Mor cliffs but the tree could not be located).

Q. *petraea x Q. robur = x Q. rosacea* Rare 1,4
Raised beach cliff near Point and south of Kilcheran.

[*Q. robur* Pedunculate Oak
This was noted by Macvicar, 1899, as a native tree but there are no modern records.]

BETULACEAE

Betula pubescens Downy Birch Local 1-5
Mainly on raised beach cliffs and other crags. The best populations are on the west coast. Tree at Salen seem to be intermediate in leaf characters between this and *Betula pendula* but the latter has not been seen, with certainty, on Lismore.

Alnus glutinosa Alder Local and populations small 2-4
Wet ground, usually by streams.

Corylus avellana Hazel Common 1-5
By far the most plentiful "tree" on the island, often forming extensive thickets on the slopes below raised beach cliffs and on steep rocky slopes inland.

CHENOPODIACEAE

Chenopodium rubrum Red Goosefoot Very rare 2
Arable ground. Killean Farm. Prior to 1994 a few plants on compost heap and on damp edge of arable field. Not seen in 1994 but apparently re-appeared in 1995.

C. album Fat-hen Very rare 2-3
Arable ground. Killean Farm

Atriplex prostrata Spear-leaved Orache 1, 3-5
Coastal shingle. There are only five records which include Sgeir nan Tom (P. Wormell, 1986); Eilean na Cloiche and Bernera.

A. glabriuscula Babington's Orache Rare 2, 4
Coastal Shingle. Port na Moralachd (AAPS 1985) and quadrant 4 (AAPS, 1969).

A. patula Common Orache
Has been reported from coastal strand lines on Lismore and also *A. laciniata* (Frosted Orache) from the same habitat at Rubha Fiart. Both species require confirmation. Indeed confusion is likely to have occurred between *A. prostrata* and *A. glabriuscula. Atriplex* is a difficult genus and more work is needed on this group in Lismore.

Salicornia agg. Glasswort Very rare 1
Tidal silt and fine shingle. Fennachrochan.

[*Suaeda maritima* Annual Sea-blite

"Salt marsh near the Pier. No personal authority is named in *Top. Bot.*, ed. 2." Macvicar, 1899]

PORTULACACEAE

**Claytonia sibirica* Pink Purslane Rare 2-3

Damp shady places, stream and pond sides. Very small populations at several places by the road between Killandrist and Clachan; occasionally naturalised at Killean Farm where the flowers are always white

Montia fontana Blinks Rather rare 1-5
Choked ditches and wet track sides.

CARYOPHYLLACEAE

Arenaria serpyllifolia Thyme-leaved Sandwort Occasional 1-5

Dry gravelly ground and wall-tops. Subsp. *serpyllifolia* has been identified north-east of Port Kilcheran.

Moehringia trinervia Three-nerved Sandwort Rare 4
Rocky ground in woodland. North end of island (10km.sq. 84) AMcGS *et al.*, 1979; Frackersaig woods.

Stellaria media Common Chickweed Frequent 1-5
Coastal strand lines and waste ground.

S. holostea Greater Stitchwort Inexplicably rather rare 1-2, 4
Woodland and bushy places.

S. graminea Lesser Stitchwort Rare 1-5
Damp grassland. Inn Island (P. Wormell, 1986); Killean Farm; Kilcheran Loch; north of Dalnarrow.

S. uliginosa Bog Stitchwort Frequent 1-5
Ditches and marshes.

Cerastium fontanum Common Mouse-ear Common 1-5
Grassland and waste ground.

C. glomeratum Sticky Mouse-ear Frequent 1-5
Gravel tracks and other bare places.

C. diffusum Sea Mouse-ear 5
Soil pockets in coastal rocks. Rare but possibly under-recorded. North end of the island (10km sq. 84), AMcGS *et al.*, 1979 and in at least two places on south-west coast.

Sagina nodosa Knotted Pearlwort 1-5
Flushes, particularly on the coast. Frequent but easily overlooked prior to flowering.

S. procumbens Procumbent Pearlwort Frequent 1-5
Rather bare places such as tracks.

S. apetala subsp. *erecta* Annual Pearlwort Rare 3-4
Shallow soils on and around rock outcrops; tracks. Killean Farm; Baligrundle (N); Barr Mor. Perhaps under-recorded.

Spergula arvensis Corn Spurrey Occasionally plentiful 1-5
Cultivated and other disturbed ground.

Spergularia media Greater Sea-spurrey 1, 3-4
Saltmarshes and therefore very local.

Lychnis flos-cuculi Ragged-Robin Frequent 1-5
Marshes and damp pastures, particularly on the coast.

Silene uniflora Sea Campion Unexpectedly rare 2-5
Coastal rock crevices and shingle. Between Castle Coeffin and Salen; Eilean na Cloiche; Kilcheran; Bernera; south end of Lismore.

S. latifolia subsp. *alba* White Campion Very rare 3
Arable and other disturbed ground. Killean Farm. Very few plants. Originally introduced with seed corn?

S. dioica Red Campion Common 1-5
Raised beach cliffs and roadside banks.

POLYGONACEAE

Persicaria amphibia Amphibious Bistort 1,2,4
The aquatic form occurs in Loch Balnagown; the terrestrial form locally in wet grassland.

P. maculosa Redshank Occasional 2-5
A weed of arable land and garden ground.

P. hydropiper Water-pepper Rare 2-4
Wet grassland. Cameron Cottage and Kilcheran area.

Polygonum arenastrum Equal-leaved Knotgrass 2-4
Tracks and similar bare ground. Probably widespread and locally plentiful.

P. aviculare Knotgrass Frequent 1-5
Tracks, roadsides and waste ground.Probably less plentiful than P. arenastrum.

**Fallopia japonica* Japanese knotweed 1, 3-4
Fortunately rare and populations small. Port Ramsay, west of Achnacroish and Kilcheran.

Rumex acetosella Sheep's Sorrel Rare 2-3,5
Dry, bare ground. Old Schoolhouse; Killean Farm; Dalnarrow.

R. acetosa subsp. *acetosa* Common Sorrel Common 1-5
Grassland.

R. crispus subsp. *crispus* Curled Dock Common 1-5
Coastal strand lines and occasionally inland.

R. crispus subsp. *littoreus* 1,5
Noted only on the north-west coast and on Bernera but probably frequent.

R. conglomeratus Clustered Dock Very rare 4
Kilcheran Loch (BHT, 1984) is the only record.

R. sanguineus var. *viridis* Wood Dock Frequent 1-5
Damp woodland.

R. obtusifolius Broad-leaved Dock 2,4-5
Roadsides and about farms. Occasional but probably under-recorded.

PLUMBAGINACEAE

Armeria maritima subsp. *maritima* Thrift Common 1-5
Coastal rocks and saltmarshes.

CLUSIACEAE

Hypericum androsaemum Tutsan (Plate 2) Frequent 1-5
Damp, shaded rocky places in woodland and on coastal cliffs.

H. perforatum Perforated St John's-wort Rare 2, 4
Dry, rough grassland and roadside. Killean Farm; Eilean na Cloiche (P. Wormell, 1986).

H. maculatum Imperforate St John's-wort Very rare 2
By stream and roadside verge. Killean Farm. A few plants only.

H. tetrapterum Square-stalked St John's-wort Frequent 1-5
Marshes, stream-sides and ditches.

H. humifusum Trailing St John's-wort 2-5
Dry banks and wall-tops. Rather rare and populations always small.

H. pulchrum Slender St. John's-Wort Common 1-5
In a wide range of drier habitats.

H.elodes Marsh St. John's wort 3
Noted by Macvicar (1899) as "rather common". Now extremely rare. Wet, peaty ditch sides. Killean Farm but no plants could be found in 1995.

DROSERACEAE

Drosera rotundifolia Round-leaved Sundew Occasional 1-5
Boggy places, particularly on more acid hummocks.

CISTACEAE

Helianthemum nummularium Common Rock-rose (Plate 2) 1-5
Limestone grassland and outcrops. Local in the north part of the island, increasing in frequency and abundance southwards. A form with very pale yellow flowers was seen by AMcGS and BHT south of Achnacroish.

VIOLACEAE

Viola riviniana Common Dog-violet Common 1-5
Woodland and rocky banks.

V. palustris Marsh Violet 1-4
Only in more acid pastures and mires and thus rather rare.

V. tricolor subsp. *tricolor* Wild Pansy Very rare 2-3
Uncommon weed in arable field. Killean Farm but none seen in 1995.

V. arvensis Field Pansy Very rare 2-3
Arable ground. Killean Farm. Only a few plants.

SALICACEAE

Populus tremula Aspen 1-5
Raised beach cliffs. Good populations are scattered along the west coast; rare, possibly absent, in the east and not seen inland.

Salix purpurea Purple Willow Rare 2,4
Wet valley bottoms. Near the Old Schoolhouse; Balure; Brynalen; and probably in one or two other places.

S. purpurea x S. viminalis = S.x. rubra Green-leaved Willow Rare 2-3
Similar wet places to above. Achuaran; Clachan; near the Old Schoolhouse; near Achnacroish.

+*S. viminalis* Osier Rare 2
Noted by Macvicar (1899) who considered it "undoubtedly planted". North of the Old Schoolhouse, and in one or two other places where it is certainly planted.

S. viminalis x S. caprea = S.x. sericans Broad-leaved Osier3
Killean Loch, presumed planted.

S. viminalis x S. caprea x S. aurita = S. x stipularis
Eared Osier Very rare 3
Roadside, Killean. C.D. Preston et al. 1990, det. R.D. Meikle. As it has long been popular to plant the larger and more ornamental Willows, it is impossible to know which populations of the above species and hybrids are truly native.

S. caprea Goat Willow Frequent 1-5
Woodland of raised beach cliffs and inland crags.

S. cinerea subsp. oleifolia Rusty Willow 2-4
Wet places. Apparently rare but probably under recorded. Clachan; Eilean Dubh (P. Wormell, 1986); Killean; Kilcheran Loch.

S. aurita Eared Willow Frequent 1-5
Woodland margins and damp rough grassland particularly in the southern half of the island.

S. aurita x S. repens = S. x ambigua 3-4
Killean Farm; rough grassland south-west of Achadun Castle, conf. R.D. Meikle. No doubt elsewhere.

S. repens Creeping Willow Locally frequent 3-5
Both damp and dry grassland.

BRASSICACEAE

*[*Sisymbrium altissium* Tall Rocket
Lismore, S.M. Macvicar, 1899 - *teste* K.N.G. Macleay. It is not mentioned in the Macvicar paper cited in the references].

S. officinale Hedge Mustard 3
A very scarce casual of disturbed ground. Killean Farm.

Arabidopsis thaliana Thale Cress Occasional 2-4
Bare soil on rock ledges.

**Hesperis matronalis* Dame's-violet 3
Abandoned garden of derelict cottage near Balveolan.

Rorippa nasturtium-aquaticum agg. Water-cress 1-5
Marshes, ditches and springs. Frequent, particularly along coasts. *R. nasturtium-aquaticum sensu stricto* has been recorded from areas 2-5 and all Lismore plants may be referable to this segregate.

Cardamine pratensis Cuckooflower Common 1-5
Wet meadows and marshes.

C. flexuosa Wavy Bitter-cress Frequent 1-5
Damp ground in woodland, gardens and among rocks.

C. hirsuta Hairy Bitter-cress Probably frequent 1,3-5
Dry bare ground.

Arabis hirsuta Hairy Rock-cressOccasional or rare 1-3,5
Dry rock ledges and wall tops, mainly coastal. Populations usually small.

Erophila verna sensu lato WhitlowgrassOccasional or rare 2-5
Dry sandy ground and on ruins. *E. verna sensu stricto* has been confirmed in areas 4 and 5 (conf. T.T. Elkington) and probably all Lismore plants are referable to this taxon.

Cochlearia officinalis Common Scurvygrass 1-5
Coastal rocks and saltmarshes. Usually small and sporadic. Luxuriant plants occur on the coast WNW of Cameron Cottage and when in flower are visible from Castle Coeffin over one kilometre away.

C. danica Danish Scurvygrass. Very rare 3
A single plant reported from rocky shore near Salen.

Capsella bursa-pastoris Shepherd's-purse Frequent 1-5
Garden and arable ground; sides of tracks.

Thlaspi arvense Field Penny-cress Very rare 2-3
Weed of arable land. Killean Farm. Not seen in 1995.

**Brassica rapa* Wild Turnip Rare 2-3
Casual. Killean Farm; a single plant west of Balygrundle.

Sinapis arvensis Charlock Rare 2-3
Arable and waste ground. Noted by MacVicar (1899); by AMcGS in 10km. square 84 (1979); Killean Farm.

**Raphanus raphanistrum subsp. raphanistrum* Wild Radish Rare 3
Casual. A single plant west of Balygrundle in 1994. Killean Farm.

ERICACEAE

Calluna vulgaris Heather Common 1-5
A widespread constituent of grassland and heath but suppressed by heavy grazing and not conspicuous. Rarely well-grown or forming pure stands.

Erica tetralix Cross-leaved Heath Rare 1-4
Confined to the few examples of wet heath. Near Port Ramsay; Eilean Dubh (P. Wormell, 1986); Killean; near Brynalen.

E. cinerea Bell Heather Locally frequent 1-2,4-5
Dry, open ledges of raised beach cliffs and rocky banks.

*Vaccinium myrtillus*Bilberry 1-5
In places where somewhat acid soils have developed, mainly on or close to raised beach cliffs. Occasional in west, rare in the east and inland.

PYROLACEAE

Pyrola minor Common Wintergreen Very rare 2
A single flowering plant in coastal Hazel wood north of Castle Coeffin.

PRIMULACEAE

Primula vulgaris Primrose Common 1-5
In a wide variety of damp habitats.

Lysimachia nemorum Yellow Pimpernel Frequent 1-5
Damp woodland and stream-sides.

**L. punctata* Dotted Loosestrife 3
Well established on roadside bank. Killean.

Anagallis tenella Bog Pimpernel Rare 3-5
Coastal flushes. Killean Farm; near Fiart Farm; south of Achadun Castle.

A. arvensis Scarlet Pimpernel Very rare 3
Killean Farm. Beside a new track and occasional in arable field. Both "scarlet" and pink-flowered plants occur.

Glaux maritima Sea-milkwort Frequent 1-5
Coastal shingle and saltmarshes.

Samolus valerandi Brookweed Frequent 1-5
Coastal flushes and damp rock crevices.

GROSSULARIACEAE

+*Ribes uva-crispa* Gooseberry 2,4
Roadsides and bushy places. Occasional and usually a single or very few bushes. South-west of Clachan; near Tirefour; Kilcheran area.

CRASSULACEAE

Sedum rosea Roseroot Rare 3,5
Raised beach cliffs. Sgeir an t-Sailein; Bernera, north side; south-west Lismore cliffs,but only a few plants.

S. acre Biting Stonecrop Frequent 1-5
Mainly on coastal rocks and shingle.

S. anglicum English Stonecrop 1-5
Similar habitats to *S. acre* and probably equally frequent.

SAXIFRAGACEAE

Saxifraga aizoides Yellow Saxifrage 2-5
Stony flushes and wet limestone outcrops. Locally plentiful on the west coast and occasionally inland.

S. granulata Meadow Saxifrage Very rare 2-3
Dry grassland in unimproved meadow. Killean Farm. Only a few small patches. Not seen in 1994 but refound in 1995.

S. tridactylites Rue-leaved Saxifrage (Plate 2)Occasional 2-5
Soil pockets on limestone rocks and wall-tops.

Chrysoplenium oppositifolium
Opposite-leaved Golden-saxifrage 1-5
Wet shady places in woodland at flushes and springs. Frequent and locally plentiful.

C. alternifolium Alternate-leaved Golden-saxifrage 1
Very scarce in Hazel woodland, Glas Dhruim.

Parnassia palustris Grass-of-Parnassus Frequent 1-5
Damp grassland and flushes.

ROSACEAE

Filipendula ulmaria Meadowsweet Common 1-5
In a wide variety of damp habitats.

Rubus saxatilis Stone Bramble Frequent 1-5
Raised beach cliffs and inland crags.

R. idaeus Raspberry Rather rare 1-5
Among rock detritus at the foot of raised beach cliffs. Bushes in the Port Ramsay and Killean areas may be of garden origin.

R. fruticosus agg. Bramble Common 1-5
Woodland margins, bushy places and roadsides.

The following segregates occur, all determinations by AMcGS.

R. dumnoniensis	2,4
R. polyanthemus	1-5
R. septentrionalis	4-5
R. subinermoides	2-4
R. latifolius	4-5
R. pictorum	2

Potentilla palustris Marsh Cinquefoil Frequent 1-5
Fens and marshes.

P. anserina Silverweed Frequent 1-5
Coastal strand lines and roadsides.

P. neumanniana Spring Cinquefoil 3-5
Dry basic grassland and limestone outcrops. Apparently absent at the north end of the island, most frequent in the south-west.

P. erecta Tormentil Common 1-5
In a wide variety of grassland and other habitats.

P. reptans Creeping Cinquefoil Very rare 3
Disturbed ground. Killean Farm. Not seen in 1995.

P. sterilis Barren Strawberry Common 1-5
Basic grassy banks and woodland.

Fragaria vesca Wild Strawberry Common 1-5
Damp banks, outcrops and woodland.

Geum rivale Water Avens Frequent 1-5
Stream-sides and in wet places in woods and on crags.

G. urbanum Wood Avens Occasional 1-2,4-5
Drier ground in woodland and a garden weed at Hawthorn House!

Dryas octopetala Mountain Avens (Plate 2) 5
Short limestone grassland and outcrops. Local in south-west: Bernera, south-west end; Druim Mor.

Agrimonia eupatoria Agrimony
Dry ledges and slopes below raised beach cliffs. Agrimony is a frequent plant on Lismore and recorded from all five areas. The two species can only be separated satisfactorily when in fruit but it is probable that most Lismore plants are *A. eupatoria* which is reliably recorded from the areas 1 - 2, 4-5.

A. procera Fragrant Agrimony
East coast, E.C. Wallace, 1949 (*Watsonia* 2,43); coast south of Achnacroish. (A.G. Kenneth and BHT, 1984).

+*Sanguisorba minor* Salad Burnet 3
Two plants at entrance to Killean Farm. Presumed introduction with wild-flower seed.

Alchemilla xanthochlora Intermediate Lady's-mantle Rare 1-2,4
Grassland. 10 km. square 84 (AMcGS, 1979); Balimackillichan-Port Ramsay, only a few sites; Kilcheran area.

A. filicaulis subsp. vestita Hairy Lady's-mantle 2,4-5
Basic grassland. Rather rare, perhaps under-recorded.

A. glabra Smooth Lady's-mantle Frequent 1-5
Grassland, stream-sides and damp ledges.

Aphanes arvensis agg. Parsley-piert Occasional 1-5
Dry tracks and sandy ground. *A. inexspectata* has been identified at Killean Farm, Eilean na Cloiche and Bernera and it is likely that all Lismore plants are referable to this segregate.

Rosa pimpinellifolia Burnet Rose Locally frequent 1-5
Ledges of dry limestone outcrops, mainly coastal.

R. pimpinellifolia x R. mollis = R x sabinii 2
Foot of raised beach cliff south-east of Castle Coeffin. Growing with large bushes of *R. pimpinellifolia* but *R. mollis* absent. Det. G.G. Graham.

R. canina Dog-rose Probably frequent 2-3,5
Woodland margins, bushy places and raised beach cliffs. Distribution not yet fully known.

R. caesia subsp. *glauca* Glaucous Dog-rose Frequent 1-5
Habitat as for *R. canina*.

R. sherardii Sherard's Downy-rose Frequent 1-5
Habitat as for *R. canina*.

R. mollis Soft Downy-rose 3
Bank by access to Killean Farm. Almost certainly elsewhere.

Prunus spinosa Blackthorn 1-5
Raised beaches and woodland margins. Common along coasts, less so inland.

P. avium Wild Cherry Rare 2-4
Raised beach cliffs and ravines. Balnagown; Port na Moralachd; Salen; Kilcheran.

P. padus Bird Cherry 4
Reported from the Kilcheran area in 1987. Could well occur but as there are no other records of native trees, and as *P. avium* could have been intended, confirmation is desirable.

Sorbus aucuparia Rowan Frequent 1-5
Woodland and cliffs.

**S. intermedia* Swedish Whitebeam 2
A single self-sown tree in mixed broad-leaved woodland south of Port na Moralachd; a single tree behind Hawthorn House but perhaps planted.

S. rupicola Rock Whitebeam (Plate 2) 2-5
Raised beach cliffs on the west coast from Port na Moralachd southwards. Most plentiful in south-west and on Bernera. Usually inaccessible.

**Cotoneaster integrifolius* Small-leaved Cotoneaster 2-4
Raised beach cliffs, walls and ruins. Well naturalised in a number of places as at Castle Coeffin, Salen and Kilcheran.

Crataegus monogyna Hawthorn Common 1-5
Scrub woodland, base of crags and roadsides.

FABACEAE

Anthyllis vulneraria Kidney Vetch Frequent 1-5
Basic grassland and limestone outcrops particularly on coasts. Subsp. *vulneraria* was identified south of Achnacroish and Lismore plants may all be referable to this segregate.

Lotus corniculatus Common Bird's-foot-trefoil Common 1-5
Grassland and rock outcrops.

L. pedunculatus Greater Bird's-foot-trefoil Rare 2-4
Wet grassland. Killean Farm; Kilcheran area.

Vicia cracca Tufted Vetch Frequent 1-5
Bushy places and rough grassland.

V. sylvatica Wood Vetch Rare 1,5
Ledges of raised beach cliffs. Slughan and Druim Mor.

V. sepium Bush Vetch Common 1-5
Bushy places and cliff ledges.

[**V. sativa subsp. sativa* Common Vetch Very rare 3
Killean Farm. Vegetable plot which is being converted to tree nursery so will probably disappear].

Lathyrus pratensis Meadow Vetchling Frequent 1-5
Grassland and bushy places.

*_Pisum sativum_ var. _arvense_ Field Pea 2
Planted as part of a mixed silage crop at Baileouchdarach and one or two plants as weeds in a barley field near the Old Schoolhouse.

Medicago lupulina Black Medick Very rare 3
Dry grassland between limestone outcrops. Killean Farm.

Trifolium repens White Clover Common 1-5
Grassland, roadsides and tracks.

T. dubium Lesser Trefoil Occasional 2-5
Short grassland and gravelly ground.

T. pratense Red Clover Common 1-5
Grassland.

[_T. medium_ Zigzag Clover 2
Unimproved grassland. Killean Farm. One plant, now lost]

Ulex europaeus Gorse Rare 2-4
Rough grassland. Near Whin House!; Eilean Dubh (P. Wormell, 1986); north-west of Baligrundle (N); Kilcheran area.

HALORAGACEAE

Myriophyllum spicatum Spiked Water-milfoil 2,4
A submerged aquatic in Loch Balnagown, Kilcheran Loch and Loch Fiart.

LYTHRACEAE

Lythrum salicaria Purple-loosestrife Rare 2,4
Loch margins. Loch Balnagown and Kilcheran Loch.

ONAGRACEAE

Epilobium parviflorum Hoary Willowherb Frequent 1-5
Ditches and stream-sides.

E. montanum Broad-leaved Willowherb Frequent 1-5
Woodland and shady places on crags.

E. obscurum Short-fruited Willowherb Rare 1-3,5
Marshes and ditches. Few records which include Port Ramsay, Killean Farm and Bernera.

*_E. ciliatum_ American Willowherb 2
Garden weed at the Old Schoolhouse.

E. palustre Marsh Willowherb Frequent 1-5
Marshes and choked ditches.

*_E. brunnescens_ New Zealand Willowherb Rare or overlooked 3
Bare, wet stony places. Disused quarry at Salen.

Chamerion angustifolium Rosebay Willowherb Rare 1,4-5
Walls of ruined buildings and bushy ground. Fennachrochan; Eilean na Cloiche; Kilcheran; Dalnarrow.

*_Fuschsia magellanica_ Fuchsia 1-4
Walls and banks. Occasionally naturalised near habitations as at Achueran House, Killean Farm and Kilcheran.

Circaea lutetiana Enchanter's-nightshade Local or rather rare 2-5
Woodland and other shady places. Balnagown; garden weed at Hawthorn House; Killean Farm; Eilean na Cloiche (P. Wormell, 1986); probably several places in Kilcheran area; Bernera (AAPS and AMcGS, 1979).

C. lutetiana x C. alpina = C. x intermedia
Upland Enchanter's-nightshade Occasional 1-5
Woodland and shady places among boulders and under bracken.

AQUIFOLIACEAE

Ilex aquifolium Holly Occasional 1-5
Raised beach cliffs. Usually solitary and trees frequently small and wind-blasted.

EUPHORBIACEAE

Mercurialis perennis Dog's Mercury Common 1-5
Woodland, shady recesses on crags and among boulders.

Euphorbia helioscopia Sun Spurge Rare 2-4
Cultivated ground. Weed in mixed silage field at Baileouchdarach; Killean Farm; garden ground Kilcheran.

E. peplus Petty Spurge Very rare 2-3
Cultivated ground. Killean Farm.

LINACEAE

Linum catharticum Fairy Flax Common 1-5
Limestone outcrops and grassland.

Radiola linoides Allseed Very rare 3
At the edge of a new track at Killean Farm in 1992 but not seen since.

POLYGALACEAE

Polygala vulgaris Common Milkwort Frequent 1-5
Limestone outcrops and cliff ledges.

P. serpyllifolia Heath Milkwort 1-5
Characteristic of acid grassland and heaths. Less frequent than _P. vulgaris_ on Lismore but true status unclear because of probable confusion between the two species.

ACERACEAE

*_Acer pseudoplatanus_ Sycamore 1-5
Frequently planted, as in the policies of Achueran House. Self-sown trees are frequent, mainly on coasts, in the northern half of the island.

OXALIDACEAE

Oxalis acetosella Wood-sorrel Frequent 1-5
Damp shady places: woodland, among boulders and under bracken.

GERANIACEAE

Geranium pratense Meadow Crane's-bill Local 2
Roadsides, field margins and rough grassland. In several places in the Clachan-Balnagown - Tirefour area.

G. columbinum Long-stalked Crane's-bill 1-5
Limestone outcrops, grassland and coastal shingle. Rather rare and populations always small: Point; Killean Farm; Kilcheran; Bernera; etc..

G. dissectum Cut-leaved Crane's-bill Rare 2-4
Disturbed ground and grassland. Bachuil; Balnagown; Killean Farm; Loch Fiart area; Kilcheran.

[_G. pusillum_ Small-flowered Crane's-bill
Reported in 1992 at Port Kilcheran but confirmation required].

G. molle Dove's-foot Crane's-bill Occasional 1-4
Short dry grassland, outcrops and shingle.

G. lucidum Shining Crane's-bill Occasional 1-5
Soil pockets on coastal limestone outcrops, boulders and walls.

G. robertianum Herb-Robert Common 1-5
Woodland, rocky roadside banks and cliff ledges.

ARALIACEAE

Hedera helix Ivy Common 1-5
Coastal and inland cliffs, occasionally on trees particularly on the east coast.

APIACEAE

Hydrocotyle vulgaris Marsh Pennywort Frequent 1-5
Wet coastal grassland and loch margins.

Sanicula europaea Sanicle Common 1-5
Damp shady woodland and cliff ledges.

Anthriscus sylvestris Cow Parsley Local 1-5
Roadsides and rough grassland. Several places in the north-east; Eilean na Cloiche; Bernera (P. Wormell, 1983).

[**Myrrhis odorata* Sweet Cicely 1
Noted for Sgeir nan Tom (P. Wormell 1986). Its occurrence on a tiny uninhabited island seems odd and confirmation is desirable].

Conopodium majus Pignut Common 1-5
Grassland.

**Aegopodium podagraria* Ground-elder
Occasional near habitations 1-4
Roadsides and garden ground.

Berula erecta Lesser Water-parsnip Very rare 2
Stream below Cameron Cottage.

Oenanthe lachenalii Parsley Water-dropwort Rare 1, 3-4
Saltmarshes. Rubha Ban (very scarce); Salen; Achadun Bay.

O. crocata Hemlock Water-dropwort
Locally frequent 2,4-5
Ditches and wet stony places near the sea.

Apium graveolens Wild Celery 3
A few plants by a recently formed pond at Killean Farm.

A. nodiflorum Fool's Water-cress Rare 1-2
Slow flowing streams and ditches. Near Port Ramsay; Balnagown.

Ligusticum scoticum Scots Lovage
Rare and populations small 1,4-5
Fissures of coastal rocks. Port Ramsay tidal island; Sgeir nan Tom (P. Wormell, 1986); Achadun; Eilean Dubh and/or Eilean na Cloiche (P. Macpherson, 1964); Creag Island (P. Wormell, *c.* 1986); Port an Rubha.

Angelica sylvestris Wild Angelica Common 1-5
Stream-sides, marshes and wet ledges.

Heracleum sphondylium Hogweed Common 1-5
Roadsides and rough grassland.

Torilis japonica Upright Hedge-parsley Frequent 1-5
Dry banks, particularly at the foot of raised beach cliffs.

[*T. arvensis* Spreading Hedge-parsley Cornfields, Lismore (Lightfoot, 1777). Not mentioned by Macvicar (1899) and there are no modern records].

Daucus carota Wild Carrot Locally plentiful 1-5
Dry grassland and ledges close to the sea.

GENTIANACEAE

Centaurium erythraea Common Centaury Locally frequent 1-5
Short grassland and ledges of limestone outcrops, mainly coastal.

Gentianella campestris Field Gentian 1-4
Short limestone grassland. The few records suggest it is rare, but it is late flowering and probably under-recorded. Near Achueran House; Rubha Ban; Killean Farm; Frackersaig; Kilcheran area.

SOLANACEAE

Solanum dulcamara Bittersweet Very rare 2-3
Edge of alder plantation and on stream bank. Killean Farm.

**S. tuberosum* Potato 5
A short-lived casual. Near Dalnarrow and probably elsewhere.

CONVOLVULACEAE

**Calystegia silvatica* Large Bindweed 2
Bushy ground at Achnacroish, well established.

**C. pulchra* Hairy Bindweed 3
Abandoned garden of derelict cottage near Balveolan.

MENYANTHACEAE

Menyanthes trifoliata Bogbean Locally frequent 2-5
Slow-flowing streams, loch margins and fens.

BORAGINACEAE

[*Lithosperum officinale* Common Gromwell
"Lismore. Macvicar in lit. A.B. 9.10.1899" teste K.N.G. MacLeay. No other records. It could well occur].

[*Echium vulgare* Viper's-bugloss 2
Bachuil: one plant, casual in hayfield, c. 60 years ago. Teste L.J.M. Stewart].

Myosotis scorpioides Water Forget-me-not 3
Beside small, newly formed pond at Killean Farm. Records for Kilcheran Loch and lochan south of Loch Fiart are both probable errors.

M. secunda Creeping Forget-me-not Rare 1-3
Rather bare ground in flushes. Port na Moralachd (north end); Port Ramsay; Killean Farm.

M. laxa subsp. caespitosa Tufted Forget-me-not Frequent 1-5
Loch and stream-sides, marshes and ditches.

M. arvensis Field Forget-me-not Occasional 2-5
Dry grassland at base of coastal cliffs and in bushy places.

M. discolor Changing Forget-me-not Rare or overlooked 2,4
Dry grassland and track-sides. 10 km sq. 84 (AMcGS, 1979); Killean Farm; coast at Miller's Port.

LAMIACEAE

Stachys sylvatica Hedge Woundwort Frequent 1-5
Woodland and other sheltered places.

S. sylvatica x S. palustris = S. x ambigua Very rare 3
Roadside at Frackersaig.

S. palustris Marsh Woundwort Unexpectedly rare 2-4
Barley field near Old Schoolhouse; Killean Farm; damp ground on coast at Miller's Port.

Lamium album White Dead-nettle Very rare 3
Garden and other disturbed ground. Killean Farm. Not seen in 1995.

L. purpureum Red Dead-nettle Rare 1-3
Garden and other disturbed ground. Point and Killean Farm.

L. hybridum Cut-leaved Dead-nettle 2 or 3
Scarce in arable field, Killean Farm.

L. confertum Northern Dead-nettle Very rare 2-3
Killean Farm. Uncommon in arable field and not found every year. Not found in 1995.

Galeopsis speciosa Large-flowered Hemp-nettle Very rare 2-3
Killean Farm. Formerly quite common in arable field but scarce in 1995.

G. tetrahit agg. Common Hemp-nettle 2-4
Strand-lines and arable land. Apparently rather rare. Weed in silage crop Baileouchdarach (= *G. tetrahit sensu stricto*); Killean Farm (= *G. bifida* and *G. tetrahit*); Eilean Dubh (P. Wormell, 1986).

Scutellaria galericulata Skullcap Rare 2,4-5
Damp stony ground on coasts. Tirefour; Kilcheran area; coast south of Bernera; Rubha Fiart.

S. minor. Lesser Skullcap Rare 1,5
Wet coastal flushes. Eilean Ramsay (P. Wormell, 1986); Bernera.

Teucrium scorodonia Wood Sage Common 1-5
Open woodland and crag ledges.

Ajuga reptans Bugle Frequent 1-5
Damp ground in woodland and other shady places.

Glechoma hederacea Ground-ivy Rare 1,3
Woodland near Fennachrochan; roadside verges in centre of island but few sites and populations small.

Prunella vulgaris Selfheal Common 1-5
In a wide range of damp habitats.

Clinopodium vulgare Wild Basil 1-4
Dry ledges of raised beach cliffs. Scattered along the north and east coasts from Glas Dhruim in north-west to Kilcheran in the south.

Thymus polytrichus subsp. *brittanicus* Wild ThymeCommon 1-5
Short dry grassland and limestone outcrops.

Lycopus europaeus Gipsywort Very rare 4
Damp ground above shore. South side of Port Kilcheran.

Mentha aquatica Water Mint Common 1-5
Stream-sides and flushes.

**M. aquatica x M. spicata = M. x piperita* Peppermint Rare 2-3,5
Naturalised in streams: below Cameron Cottage; near Balveolan; Dalnarrow.

HIPPURIDACEAE

Hippuris vulgaris Mare's-tail 2-5
Shallow loch margins and wet fens. At all three main lochs; occasional elsewhere.

CALLITRICHACEAE

Callitriche stagnalis Common Water-starwort Rare or under-recorded 2,4
Shallow water of pond margins and ditches. Balure; Killean Farm; south-east of Balygrundle.

S. hamulata Intermediate Water-starwort Rare 3-4
Ponds and ditches. Acid ditch near Creag an Fhithich; pond south-east of Balygrundle.

PLANTAGINACEAE

*Plantago coronopus*Buck's-horn Plantain Frequent 1-5
Short dry grassland and soil pockets in rocks, always coastal.

P. maritima Sea Plantain 1-5
Short dry grassland and rock fissures. Common on coasts, frequent inland.

P. major Greater Plantain Common 1-5
Tracks, roadsides and waste ground.

+*P. media* Hoary Plantain
A single plant in 1995 at entrance to Killean Farm. Assumed introduction with wild-flower seed.

P. lanceolata Ribwort Plantain Common 1-5
Damp grassland in a wide range of habitats.

Littorella uniflora Shoreweed 2,4
Shallow water of loch margins. Loch Balnagown; Kilcheran Loch; Loch Fiart.

OLEACEAE

Fraxinus excelsior Ash Common 1-5
Mainly in woodland and on cliffs and crags.

SCROPHULARIACEAE

Scrophularia nodosa Common Figwort Occasional 1-5
Damp woodland and other sheltered places.

**Mimulus moschatus* Musk 3
Damp ground. Killean Farm. A few plants at one site. Not yet fully naturalised.

**Mimulus* Monkeyflower
Monkeyflowers occur in a number of places, in streams and ditches, in quadrants 1-3. The following have been determined:

**M. guttatus* Monkeyflower (Plate 3) 2-3
Quadrant 2, unlocalised (J.H. Dickson, 1991); Killean Loch; north of Baligrundle (N) (BSBI Field Meeting 1992, det. AMcGS).

**M. guttatus x M. luteus = M. x robertsii* 1-2
Port Ramsay and stream below Cameron Cottage (both 1994, det. BHT); Loch Balnagown (C.D. Preston et al 1990, det. A.J. Silverside; *ibid.* BHT 1994, det. BHT).

**Cymbalaria muralis* subsp. *muralis* Ivy-leaved Toadflax Rare 1
Side of gravel track in village, Port Ramsay; old garden and field walls: seen at several places by AMLB but the localities cannot be recalled.

Digitalis purpurea Foxglove Frequent 1-5
Roadside banks, cliffs and woodland margins.

**Erinus alpinus* Fairy Foxglove 2,4
Naturalised on garden walls of Hawthorn House to where it was introduced from the following: plentiful on a ruin at Kilcheran and on the mortared masonry joints of the disused lime-kiln at Port Kilcheran. A few plants have spread on to natural limestone outcrops close by at the last place.

Veronica serpyllifolia subsp. *serpyllifolia* Thyme-leaved Speedwell Occasional 1-5
Gravel tracks and damp grassland.

V. officinalis Heath Speedwell Rare 2-4
Non-calcareous grassland. Killean Farm and Barr Mor.

V. chamaedrys Germander Speedwell Common 1-5
Woodland and grassy banks.

V. montana Wood Speedwell Very rare 4,?5
Damp woodland. West of Kilcheran Loch. It has also been reported from Bernera but confirmation of its occurrence there is needed.

V. scutellata Marsh Speedwell 1,3-4
Marshes and flushes. Rare but probably under-recorded. Port na Moralachd (north end); near Stronacroibh; Kilcheran Loch; Loch Fiart.

V. beccabunga Brooklime 1-5
Streams, springs and runnels. Common on coasts, less frequent inland.

V. anagallis-aquatica Blue Water-speedwell Frequent 1-5
Slow-flowing streams and ditches.

V. arvensis Wall Speedwell Occasional 1-5
Wall-tops and sandy ground.

V. agrestis Green Field-speedwell Very rare 2-3
Cultivated ground. Killean Farm. A few plants in arable field.

**V. persica* Common Field-speedwell Rare 1-3
Cultivated and other disturbed ground. Port Ramsay (a white-flowered form) and Killean Farm.

**V. filiformis* Slender Speedwell Very rare 2-3
Grassy ground. Killean area.

Melampyrum sylvaticum Small Cow-wheat Rare 2,4-5
Woodland. Good populations in escarpment Hazel wood west of Creag Sgeanach; very scarce in woodland west of Kilcheran Loch; small population in Hazel wood at foot of raised beach cliff, Bagh Clach an Dobhrain.

Euphrasia officinalis sensu lato Eyebright Common 1-5
In a wide variety of grassland habitats. Apart from a record of *E. micrantha* at Port Ramsay (det. A. AMcGS) there is virtually no other information on segregates.

Odontites vernus Red Bartsia Occasional 1-5
Track and roadsides, damp grassland.

Rhinanthus minor Yellow-rattle Frequent 1-5
Grassland.

Pedicularis palustris Marsh Lousewort Frequent 1-5
Marshy places.

P. sylvatica Lousewort Frequent 1-5
Heaths and non-calcareous grassland.

OROBANCHACEAE

Orobanche alba Thyme Broomrape 2-3,5
Surprisingly rare in view of the abundance of Thyme in many places. Balure (W.A. Sledge, 1949); Killean Farm, seen in 1993 but not since; east of Tirlaggan; Dun Chruban.

LENTIBULARIACEAE

Pinguicula lusitanica Pale Butterwort Rare 1-3
Eroded areas in peaty flushes. Fennachrochan bay; south-west of Stronacroibh; Killean Farm.

P. vulgaris Common Butterwort Frequent 1-5
Wet peaty flushes and banks.

Urticularia vulgaris sensu lato Bladderwort Local 2-4
Lochs and fens. Loch Balnagown; fen below Argyll Cottage; Kilcheran Loch; Loch Fiart.

CAMPANULACEAE

Campanula rotundifolia Harebell Common 1-5
Dry grassland, ledges and rock fissures.

(*Lobelia dortmanna* Water Lobelia 3
A single plant in a peaty pond south of Creag an Fhithich. It could not be refound and was doubtless a short-lived introduction, perhaps by waterfowl. The main Lismore lochs are too calcareous for this species.)

RUBIACEAE

Sherardia arvensis Field Madder Verry rare 1
Dry rocky grassland. North end Lismore, S. Macpherson, 1965 (*Proc. BSBI.* 6, 243) and, perhaps the same site, one small colony near the passenger ferry jetty. (AAPS, c. 1979). Could not be located in 1994.

Galium boreale Northern Bedstraw Local 3-5
Dry calcareous grassland, outcrops and cliff ledges. Coastal cliffs north-west of Baleveolan and south-west coast including Bernera.

G. odoratum Woodruff Occasional 1-5
Rocky banks in woodland.

G. palustre Marsh-bedstraw Frequent 1-5
Marshes and wet grassland.

G. verum Lady's Bedstraw Common 1-5
Dry calcareous grassland, outcrops and cliff ledges.

G. sterneri Limestone Bedstraw Rare 2-4
Calcareous grassland. Killean Farm; quadrant 4(AAPS, 1969 - as *G. pumilum*).

G. saxatile Heath Bedstraw 1-5
Non-calcareous grassland and heath. Infrequent because of the shortage of these habitats.

G. aparine Cleavers Frequent 1-5
Among boulders and on margins of scrub. Mainly coastal.

CAPRIFOLIACEAE

Sambucus nigra Elder Occasional 1-3,5
Woodland margins and roadsides. Macvicar (1899) noted this as "undoubtedly planted". Obviously self-sown trees are widely scattered, for example Glas Dhruim and Bernera.

Lonicera periclymenum Honeysuckle Frequent 1-5
Woodland and cliff ledges.

ADOXACEAE

Adoxa moschatellina Moschatel Local 1-2,4

Shady places in coastal woodlands. Good populations at Glas Dhruim.

VALERIANACEAE

Valerianella locusta Common Cornsalad Rare 2,4

Dry rocky places. Killean Farm; 10 km. square 84 (AMcGS *et al.*, 1979) quadrant 4 (AAPS, 1969 and AAPS *et al*), 1980); south of Lochan Treshtil but very scarce.

Valeriana officinalis Common Valerian Occasional 1-5
Stream-sides.

DIPSACACEAE

[*Knautia arvensis* Field Scabious

Formerly grew on field edge opposite the Old Schoolhouse but almost certainly not native. (L.J.M. Stewart pers. comm.)].

Succisa pratensis Devil's-bit Scabious Common 1-5

Damp grassland in a wide variety of habitats.

ASTERACEAE

Arctium minus subsp. *nemorosum* Wood Burdock
Occasional 2-5
Base of raised beach cliffs, often in woodland and where sheep lie-up.

Cirsium vulgare Spear Thistle Common 1-5
Drier grassland and roadsides.

C. palustre Marsh Thistle Common 1-5
Damp pastures and flushes.

C. arvense Creeping Thistle Common 1-5
Drier grassland and waste places

Centaurea nigra Common Knapweed Common 1-5
Rough grassland and roadsides.

Lapsana communis subsp. *communis* Nipplewort Frequent 1-5
Dry banks and ledges at the foot of raised beach cliffs. Rarely inland.

Hypochaeris radicata Cat's-ear Common 1-5
Dry banks and outcrops.

Leontodon autumnalis Autumn Hawkbit Frequent 1-5
Damp grassland and flushes.

L. hispidus Rough Hawkbit Very rare 2-3
Unimproved grassland. Killean Farm.

**Tragopogon porrifolius* Salsify Very rare 3
Killean Farm. Origin unknown. Was formerly common in vegetable plot but probably lost here as a result of tree nursery development. Not seen in 1995.

Sonchus arvensis Perennial Sow-thistle Rare 4-5
Coastal strand-lines. 10 km. square 84 (AMcGS *et al*, 1979); Kilcheran; Eilean na Cloiche (P. Wormell, 1986); Bernera (P. Wormell, 1983).

S. oleraceus Smooth Sow-thistle Rare 3-4
Weed of cultivation Killean Farm; waste ground near Baligrundle (N); ledges of coastal cliffs at Port Kilcheran and to the south, scarce.

S. asper Prickly Sow-thistle Frequent 1-5
Dry banks and ledges at the base of cliffs, mainly coastal.

Mycelis muralis Wall Lettuce Very rare 5
Reported as growing at the base of a raised beach cliff, north-east Bernera, 1994. Confirmation desirable. It occurs at Port Appin on the mainland, some 14 km. to the north-east.

Taraxacum Dandelions Common 1-5
In a wide range of habitats.

The following segregates have been reliably recorded. Determinations are by either A.A. Dudman, A.J. Richards or AMcGS. The known area distribution is indicated (some records can only be assigned to 10 km. square 84) but at present this must be considered as very incomplete.

Section Erythrosperma		
T. brachygossum	(84) AMcGS, 1979	
T. lacistophyllum		3
Section Spectabilia		
T. faeroense		1-2,4-5
Section Naevosa		
T. maculosum		2-3
T. naevosiforme	(84) AMcGS, 1979	
Section Celtica		
T. nordstedtii		2-4
T. subbracteatum		2
T. unguilobum		2-5
Section Hamata		
T. hamatum		3
Section Ruderalia		
T. cyanolepis	(84) AMcGS, 1979	
T. dahlstedtii	(84) AMcGS, 1979	

Crepis paludosa Marsh Hawk's-beard Locally frequent 1-4
Wet places in woodland and by streams.

C. capillaris Smooth Hawk's-beard Rare or overlooked 2,4
Dry banks and rocky places. Achuaran; Balnagown; Killean Farm; coast north and south of Port Kilcheran.

Pilosella officinarum Mouse-ear Hawkweed. Common 1-5
Dry grassland, particularly in rocky places.

Hieracium Hawkweeds Common 1-5
Ledges of cliffs and disused quarries, particularly on coasts.

The following segregates have been reliably recorded. Older, dated, records were identified by Sell and West. Post 1986 records all determined D.J. McCosh or AMcGS. The known area distribution is indicated but at present this must be considered as very incomplete.

Section Vulgata		
H. cravoniense		3
H. vulgatum		1-5
H. rubiginosum		3
H. orcadense	Achnachroish, 1963	2 or 3
H. orithales	AMcGS, 1969	4
H. subhirtum		4
H. cymbifolium	AMcGS, 1960 and 1969	4-5
H. duriceps		2
Section Oreadea		
H. sommerfeltii		5
H. ebudicum		2
Section Cerinthoidea		
H. iricum		2
H. anglicum		2-3,5
H. ampliatum		5
H. herbridense	Lismore. *Watsonia* 8, 97-120 (1970)	2-3
H. shoolbredii		2-4
Section Subalpina		
H. petrocharis	AMcGS, 1960	3, 5

Antennaria dioica Mountain Everlasting Local 2-5
Dry grassland and heath. Apparently absent at the extreme north end; most frequent in the south.

Gnaphalium uliginosum Marsh Cudweed Occasional 1-4
Damp tracks and roadsides.

**Inula helenium* Elecampane Unlocalised
BSBI field Meeting, 1963. (Proc. BSBI. 6, 194) Used to grow at the old powder magazine for Salen quarry, and may still do so (L.J.M. Stewart, pers. comm.).

Solidago virgaurea Goldenrod Frequent 1-5
Rocky banks, cliff ledges and woodland.

Aster tripolium Sea Aster Rare 1,3
Saltmarshes. Port Ramsay and Salen.

Bellis perennis Daisy Very common 1-5
Damp grasslands.

**Tanacetum parthenium* Feverfew Rare 1,4
Walls. Port Ramsay and Kilcheran

**T. vulgare* Tansy
10km square 84. AMcGS et al., 1979.

[*Artemisia vulgaris* Mugwort Macvicar (1899). No other records].

Achillea ptarmica Sneezewort Occasional 1-5
Wet non-calcareous soils.

A. millefolium Yarrow Common 1-5
Drier grasslands.

Anthemis arvensis Corn Chamomile Very rare 2-3
Killean Farm. Cultivated areas.

Chrysanthemum segetum Corn Marigold Rare 2-3
A very attractive weed of arable land. Three plants in small barley field near Old Schoolhouse (1994); Killean Farm.

Leucanthemum vulgare Oxeye Daisy Infrequent 1-4
Roadsides and cliff ledges. Surprisingly infrequent and not seen at the south end of the island.

**Matricaria discoidea* Pineappleweed Occasional 1-5
Tracks, farmyards and arable land. Occasional but sometimes abundant.

Tripleurospermum maritimum Sea Mayweed Infrequent 1-2, 4-5
Coastal rocks and shingle, unexpectedly infrequent.

Senecio jacobaea Common Ragwort Common 1-5
Dry banks and cliff ledges.

S. aquaticus Marsh Ragwort Common 1-5
Marshes and stream-sides.

S. vulgaris Groundsel Occasional 1-4
A weed of gardens, arable land and waste ground.

**Doronicum pardalianches* Leopard's-bane
On AAPS list for 10 km square 84. No other records.

Tussilago farfara Colt's-foot Rather rare 2-4
Damp waste and stony ground. Achnacroish; near Cameron Cottage; Clachan; coast near Frackersaig; Kilcheran area.

Petasites hybridus Butterbur Occasional 2-5
Stony stream-beds

Eupatorium cannabinum Hemp-agrimony Frequent 1-5
Wet ledges of raised beach cliffs. Very rare inland.

ALISMATACEAE

Alisma plantago-aquatica Water-plantain Very local 4
Loch-side fen. Loch Fiart.

JUNCAGINACEAE

Triglochin palustre Marsh Arrowgrass Frequent 1-5
Flushes and loch margins.

T. maritimum Sea Arrowgrass Occasional 1-5
Saltmarshes, even where fragmentary.

POTAMOGETONACEAE

Unless noted otherwise records for *Potamogeton* species were made by C.D. Preston and N.F. Stewart during a two day visit in July, 1990.

Potamogeton natans Broad-leaved Pondweed 2-5
Lochs and fens with open water. Loch Balnagown; Killean Loch (A.M.L. Brooks); Kilcheran Loch; Loch Fiart; lochan north-east of Dalnarrow.

P. polygonifolius Bog Pondweed 1-5
Shallow water of loch margins, streams and wet ditches. The most frequent pondweed on Lismore. CDP and NFS recorded it in areas 3-5.

P. coloratus Fen Pondweed 2-5
Shallow water of lochs, fens and slow-flowing streams where conditions are highly calcareous. Lochs Balnagown, Killean, Kilcheran, Fiart, and lochan north-east of Dalnarrow; also in stream north of Balygrundle (BHT).

P. lucens Shining Pondweed 3-4
Deeper water of lochs. Killean Loch (A.M.L. Brooks); Loch Fiart.

P. praelongus Long-stalked Pondweed 4
Deep water of lochs. Kilcheran Loch and Loch Fiart.

P. perfoliatus Perfoliate Pondweed 3-4
Shallow to deeper water of lochs. Killean Loch (A.M.L. Brooks); Kilcheran Loch and Loch Fiart.

[*P. pusillus* Lesser Pondweed
Records for Loch Balnagown (Macvicar, 1899), for the Lismore lochs as "abundant" (West, 1905) and for Lochs Kilcheran and Fiart (E.C. Wallace, 1949, BRC VC. list.) are presumed errors and probably referable to *P. berchtoldii*.]

P. berchtoldii Small Pondweed 2-4
Shallow water of lochs. Loch Balnagown; Killean Loch (A.M.L. Brooks); Kilcheran Loch; Loch Fiart (W.A. Sledge and E.C. Wallace, 1949).

P. filiformis Slender-leaved Pondweed 2,4
Shallow water of loch margins. Loch Balnagown; Kilcheran Loch; Loch Fiart.

RUPPIACEAE

Ruppia maritima Beaked Tasselweed Rare 4-5
Brackish ponds near sea. Achadun Castle; two sites south of Rubha da Uisge.

ARACEAE

+*Arum maculatum* Lords-and-Ladies Very rare 2
Bushy roadside bank near Whin House. A small but flourishing population. Far outside its normal range so probably introduced.

LEMNACEAE

Lemna minor Common Duckweed Occasional 1-5
Shallow water of pools and ditches where there is little water movement.

JUNCACEAE

Juncus squarrosus Heath rush Local 1-3,5
Wet heaths. The main populations are at the north end of the island. Elsewhere seen only near the Old Schoolhouse, at Killean Farm and on Bernera.

J. compressus Round-fruited Rush Rare 2-3
Damp gravel track, and roadsides. Cameron Cottage; near Baleveolan; near Baligrundle (N). First recorded by W.A. Sledge and E.C. Wallace, "west of Balnagown", in 1949. (*Wats.* 2, 55. 1951).

J. gerardii Saltmarsh Locally frequent 1-5
Saltmarshes, even where fragmentary.

J. bufonius Toad Rush Frequent 1-5
Damp tracks and other bare places.

J. articulatus Jointed Rush Frequent 1-5
Stony flushes and loch margins.

J. acutiflorus Sharp-flowered Rush Common 1-5
Wet grassland, particularly along coasts.

J. bulbosus Bulbous Rush Occasional 1-5
Rather bare and wet peaty places.

J. effusus Soft-rush Common 1-5
Wet pastures.

J. conglomeratus Compact Rush Occasional 1-5
Drier pastures.

Luzula pilosa Hairy Wood-rush 2-5
Heathy banks and open woodland. Rather local and infrequent.

L. sylvatica Great Wood-rush Frequent and locally plentiful 1-5
Woodland banks and cliff ledges.

L. campestris Field Wood-rush Common 1-5
Basic grassland.

L. multiflora Heath Wood-rush Frequent 1-5
Non-calcareous grassland and heath. The two subspecies have not been investigated.

CYPERACEAE

Eriophorum angustifolium Common CottongrassOccasional 1-5
Peaty flushes and wet heaths.

E. latifolium Broad-leaved Cottongrass Locally plentiful 1-4
Base-rich flushes, mainly coastal.

E. vaginatum Hare's-tail Cottongrass Rare 1,4
Wet heaths. Port Ramsay area and west of Kilcheran Loch.

Trichophorum cespitosum Deergrass Local 1-2
Wet heaths. North end of Lismore; Eilean Dubh (P. Wormell, 1986).

Eleocharis palustris Common Spike-rush Frequent 1-5
Loch margins and shallow ponds.

E. uniglumis Slender Spike-rush Rather rare 1,3-4
Brackish coastal marshes. Port Ramsay; Port na Moralachd; Salen; Achadun; south of Port Kilcheran.

E. quinqueflora Few-flowered Spike-rush Frequent 1-5
Peaty flushes.

Schoenoplectus lacustris Common Club-rush 2-4
Deeper water (1-2m.) of lochs. Loch Balnagown; Killean Loch; Kilcheran Loch; Loch Fiart.

Isolepis setacea Bristle Club-rush Occasional 1-2,4-5
Bare wet places, for example, sides of ditches.

Blysmus rufus Saltmarsh Flat-sedge Rare 1,3-4
Saltmarshes, usually with some freshwater seepage. Port Ramsay; Port na Moralachd; Salen; Lochan Treshtil.

Schoenus nigricans Black Bog-rush 2-5
Base-rich coastal flushes and raised beach cliffs where seepage of lime-rich water occurs. Often associated with tufa formations. Apparently absent on the north coast and on the east side south to Achnacroish. Locally plentiful elsewhere.

Cladium mariscus Great Fen-sedge 4
Lochside fen. Kilcheran Loch.

Carex paniculata Greater Tussock-sedge Locally plentiful 2-5
Fens and mires. Occurring at all the island's lochs and frequently elsewhere.

C. paniculata x C. diandra = C. beckmannii 2
Loch Balnagown (J. Mitchell and AMcGS, 1984).

C. diandra Lesser Tussock-sedge 2-5
Fens and base-rich mires. Occurring in the vicinity of all the island's lochs and quite frequently elsewhere.

C. otrubae False Fox-sedge Occasional 1,3-5
Damp ground among coastal rocks

C. remota Remote Sedge Occasional 1-5
Wet ground in woods and in other shady places.

C. ovalis Oval Sedge Locally frequent 2-5
Damp pastures and track-sides.

C. echinata Star Sedge Frequent 1-5
Wet pastures and flushes.

C. dioica Dioecious Sedge Occasional 1-5
Peaty flushes.

C. curta White Sedge Rare 2,4
Fens and swampy loch margins. Modified fen south-west of Clachan; Kilcheran Loch; Loch Fiart.

C. rostrata Bottle Sedge 1-5
Edges of lochs and fens and wetter parts of mires. Frequent and often plentiful.

C. vesicaria Bladder-sedge Very rare 4
Edge of fen. North-east end of Kilcheran Loch.

C. sylvatica Wood-sedge Frequent 1-5
Damp shady ground in woodland.

C. flacca Glaucous Sedge Frequent 1-5
Flushed grassy banks and ledges of crags.

C. panicea Carnation Sedge Occasional 1-5
Wet heath and peaty flushes.

C. binervis Green-ribbed Sedge Occasional 1-5
Non-calcareous grassland and heaths.

C. distans Distant Sedge Local 1,4-5
Damp grassland among coastal rocks. Tidal island Port Ramsay; occasional south of Port Kilcheran in the east and Achadun in the west.

C. extensa Long-bracted Sedge Rare 1,4
Saltmarshes. Unlocalised, BSBI Field Meeting 1963 (*Proc. BSBI.* 6, 194); Port Ramsay; Slughan, one plant only; north of Lochan Treshtil.

C. hostiana Tawny Sedge Frequent 1-5
Basic flushes, particularly on coasts.

C. hostiana x C. viridula subsp. *brachyrryncha* Very rare 4
Coast near Achadun. Conf. A.O. Chater.

C. hostiana x C. viridula subsp. *viridula* Very rare 1
Damp turf among shore rocks on tidal island Port Ramsay. Det. A.O. Chater.

C. viridula subsp. *brachyrryncha* Long-stalkedYellow-sedge Common 1-5
Drier parts of fens and base-rich flushes. Rather common and locally plentiful.

C. viridula subsp. *oedocarpa* Common Yellow-sedge 2-5
Damp peaty flushes. Apparently rather rare but probably under-recorded. Port na Moralachd (AAPS, 1985); Killean Farm; quadrant 4(AAPS *et al.*, 1980); coast below Fiart Farm; Kilcheran Loch; Bernera.

C. viridula subsp. *viridula* Small-fruited Yellow-sedge Rare 4
Damp and rather bare ground. Kilcheran Loch and Loch Fiart. (It should also occur at Port Ramsay where its hybrid with *C. hostiana* was collected).

C. pallescens Pale Sedge Very rare 5
Damp grassland. 10km. square 84 (AMcGS, 1979); Bernera.

C. caryophyllea Spring-sedge Locally common 1-5
Dry calcareous grassland.

C. pilulifera Pill Sedge Occasional 1-5
Dry non-calcareous grassland and heaths.

C. limosa Bog-sedge Very rare 3
Fen below Argyll Cottage.

[C. aquatilis Water Sedge
Lismore lochs "less abundant" (West, 1905). West is here making a comparison with certain lochs in the Loch Ness area. There are no modern records so the sedge either awaits rediscovery or, as seems more likely, it is now extinct].

C. nigra Common Sedge Rather common 1-5
Marshes and loch and stream margins.

C. pulicaris Flea Sedge Frequent 1-5
Flushes and wet ledges.

POACEAE

Nardus stricta Mat-grass Locally frequent 1-2,4-5
Non-calcareous grasslands.

Festuca pratensis Meadow Fescue Frequent 1-5
Grasslands, mainly coastal.

F. arundinacea Tall Fescue Apparently rare 2,4
Loch shores. Loch Balnagown; Achadun area.

F. rubra Red Fescue Common 1-5
Grassland, particularly along coasts.

F. ovina Sheep's-fescue Occasional or locally frequent 1-5
Non-calcareous grassland and heathy places.

F. vivipara Viviparous Fescue Rather rare 2,4-5
Same habitats as *F. ovina*. Mainly in the south. Some records may be referable to viviparous forms of *F. rubra*.

F. filiformis Fine-leaved Sheep's-fescueOccasional 1-3,5
Same habitats as *F. ovina*.

Lolium perenne Perennial Rye-grass
Frequent, locally common 1-5
Grasslands and waste places.

Cynosurus cristatus Crested Dog's-tail Common 1-5
Grasslands on better soils.

Puccinellia maritima Common Saltmarsh-grass Occasional 1,3-5
Saltmarshes, even where fragmentary

Briza media Quaking-grass 2-4
Calcareous grassland and tolerant of both wet and dry sites. Local but sometimes plentiful as on the Tirefour coast and in the Salen area.

Poa annua Annual Meadow-grass Frequent 1-5
Tracks, garden ground and waste places.

P. trivialis Rough Meadow-grass Frequent 1-5
Damp grassland, particularly in woodland and other sheltered situations.

P. pratensis sensu lato Meadow-grass 1-5
Grassland on better soils. Frequent, perhaps locally common. This is now treated as two separate species as follows but the status of each is not yet clear.

P. humilis Spreading Meadow-grass 1-5
Recorded in all areas and probably the native species.

P. pratensis Smooth Meadow-grass 2
Abundant in hay-field at Clachan and presumably sown. No doubt elsewhere and perhaps native in some parts.

Dactylis glomerata Cock's-foot Common 1-5
Rough grassland and roadsides.

Catabrosa aquatica Whorl-grass 3
Recently formed pond at Killean Farm.

Glyceria fluitans Floating Sweet-grass Frequent 2-5
Shallow water of lochs, ponds and ditches where there is little water movement.

G. declinata Small Sweet-grass Occasional 1-2,4
Wet muddy places, for example rutted tracks and gateways.

G. notata Plicate Sweet-grass Rare 4
Loch margins and other very wet places. Achadun; Kilcheran Loch; Loch Fiart. Almost certainly in one or two other places but confirmation needed.

Melica nutans Mountain Melick Very rare 5
Ledges of raised beach cliffs. West coast below Druim Mor.

Helictotrichon pubescens Downy Oat-grass
Frequent and sometimes plentiful 1-5
Dry calcareous grassland.

H. pratense Meadow Oat-grass Very rare 4
Habitat not known but presumably calcareous grassland. "South Lismore" (AAPS, 1969).

Arrhenatherum elatius False Oat-grass Common 1-5
Rough grassland and roadsides.

**Avena fatua* Wild Oat Very rare 3
Arable ground. Killean Farm. Uncommon and not found every year.

Koeleria macrantha Crested Hair-grass Locally frequent 1,4-5
Dry calcareous grassland.

Deschampsia cespitosa subsp. *cespitosa* Tufted Hair-grass
Common 1-5
Poorly drained grassland.

S. cespitosa subsp. *parviflora* 4
Woodland by Kilcheran Loch (A.G. Kenneth, 1984).

D. flexuosa Wavy Hair-grass Locally frequent 1-5
Non-calcareous grassland and heaths.

Holcus lanataus Yorkshire-fog Frequent 1-5
In a range of grassland habitats.

H. mollis Creeping Soft-grass Rare 1-4

Damp grassland in woods and other shady places. Slughan; Creag Sgeanach area; Killean Farm; quadrant 4 (AAPS et al., 1980).

Aira caryophyllea Silver Hair-grass 4
Short calcareous grassland. Rare, but perhaps underrecorded. 10km square 84 (AMcGS, 1979); Kilcheran area.

A. praecox Early Hair-grass Rather rare but widespread 1-5
Dry shallow soils.

Anthoxanthum odoratum Sweet Vernal-grass Common 1-5
In a wide range of grassland habitats.

photo: B. H. Thompson

Lismore from Beinn Donn, Appin, looking south-west.
Port Appin below foreground; Mull hills distant beyond the Firth of Lorn; Morven at right across Loch Linnhe.

photo: Andrew Campbell / S.N.H.

Limestone grassland, south Lismore, looking north-east.

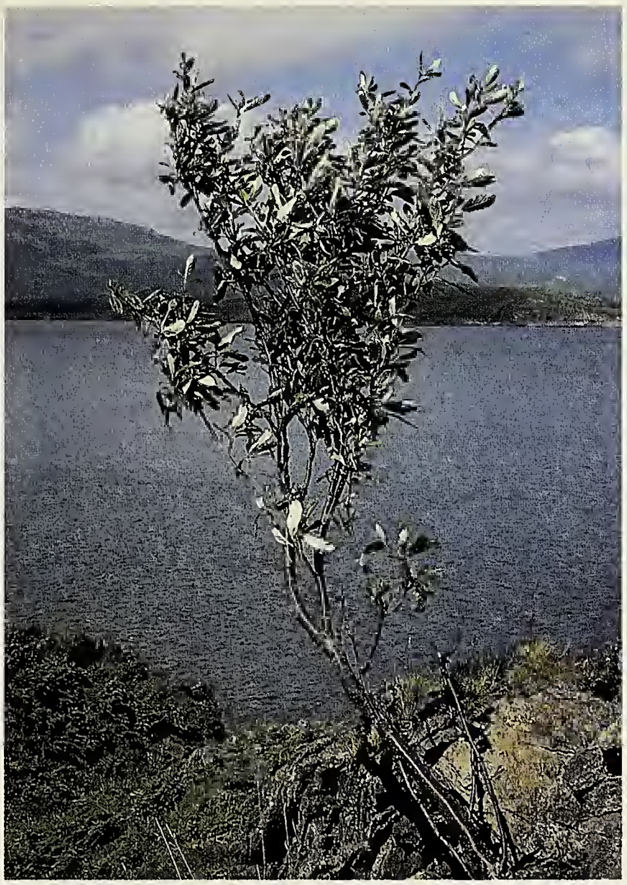


photo: A McG. Stirling

Rock Whitebeam ***(Sorbus rupicola)***
On a limestone cliff, south-west Lismore.
Mature trees are usually inaccessible.

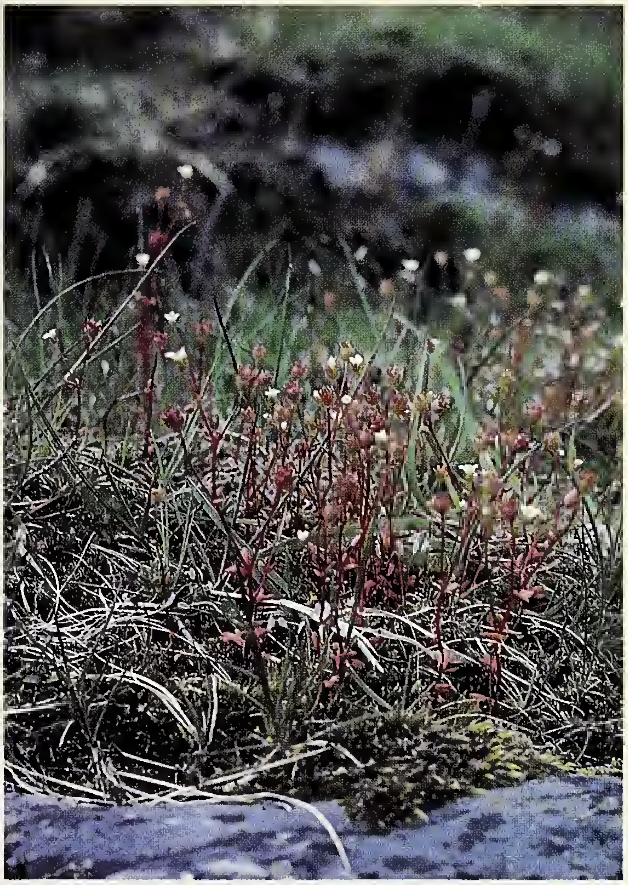


photo: A McG. Stirling

Rue-leaved Saxifrage ***(Saxifraga tridactylites)***
An annual plant of soil-pockets on rock
outcrops and wall-tops.

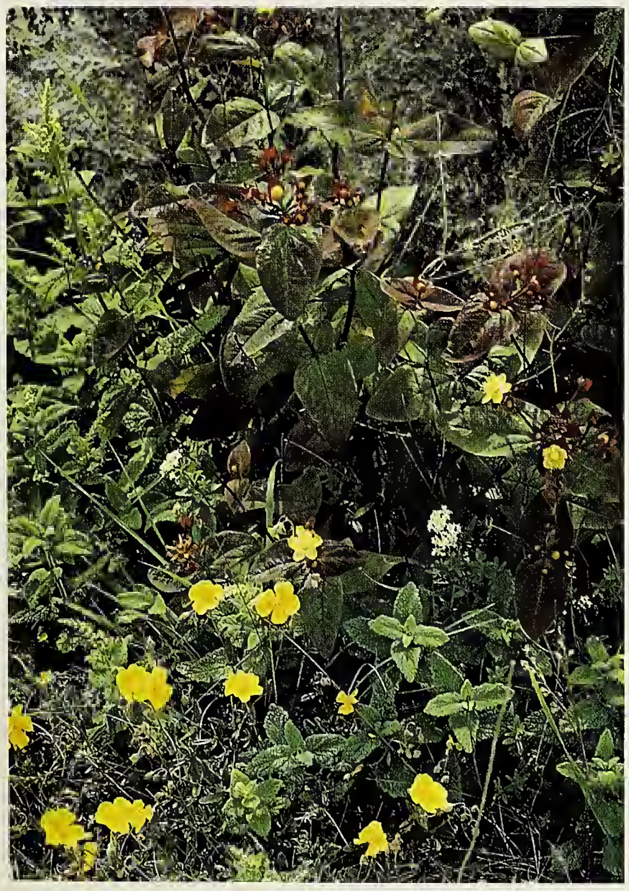


photo: Andrew Campbell / S.N.H.

Common Rock-rose ***(Helianthemum nummularium)***
and Tutsan ***(Hypericum androsaemum)***
On the island of Bernera at the south end of Lismore.

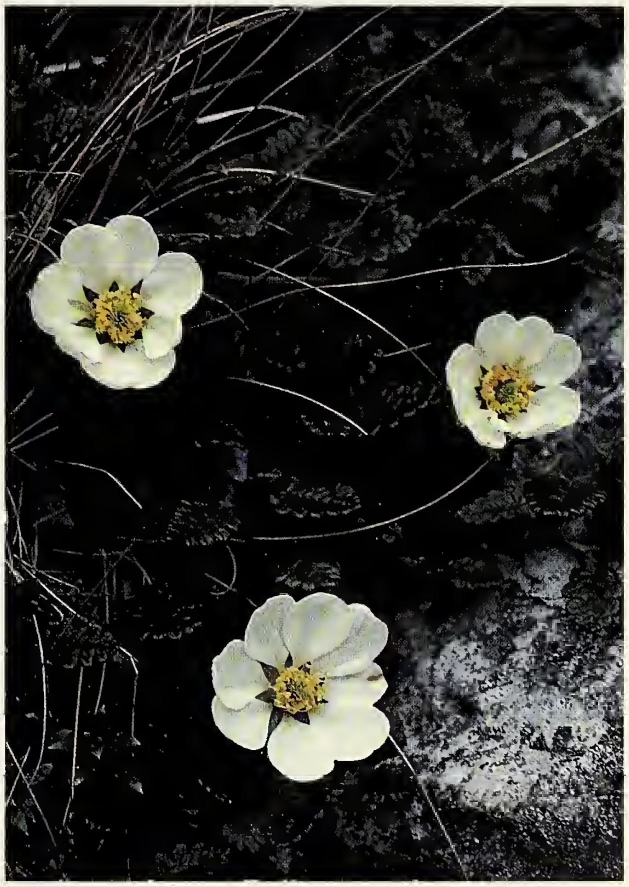


photo: A McG. Stirling

Mountain Avens ***(Dryas octopetala)***
A plant of short limestone grassland and outcrops.
Restricted to the south end of Lismore.

Phalaris arundinacea Reed Canary-grass Occasional 2-5
Wet bushy places.

Agrostis capillaris Common Bent
Frequent, perhaps locally common 1-5
Grassland.

A. stolonifera Creeping Bent Frequent 1-5
By lochs and pools and in other wet places.

A. canina sensu lato Bent Frequent 1-5
Now separated as *A. canina* (Velvet Bent) and *A. vinealis* (Brown Bent). Both segregates are known to occur but their relative frequencies have yet to be determined.

Alopecurus pratensis Meadow Foxtail Rare 3-4
Damp grassland on deeper soils. Killean Farm; one or two places in Kilcheran area.

A. geniculatus Marsh Foxtail Locally frequent 1-4
Wet pastures, particularly about gateways.

Phleum pratense Timothy Occasional 1-4
Damp grassland on deeper soils.

Bromus hordeaceus Soft-brome Rare 2-4
Dry grassland and road verges. Quadrant 2, unlocalised (J.H. Dickson, 1991); 10 km. square 84 (AMcGS, 1979); Killean Farm; roadside at Kilcheran Loch.

Bromopsis ramosa Hairy-brome Frequent 1-5
Well drained soils in shady woodland, particularly at the foot of raised beach cliffs.

Brachypodium sylvaticum False Brome Common 1-5
Shady banks in woodland and ledges of crags.

Elymus caninus Bearded Couch Rare 3
Shady banks in woodland and cliff ledges. On AAPS list (as *Agropyron caninum*); coast south of Achnacroish.

Elytrigia repens Common Couch 2-4
Foreshores, garden and waste ground. Few records but probably overlooked. 10 km. square 84 (AMcGS, 1979); Old Schoolhouse; Killean Farm; Kilcheran area.

Danthonia decumbens Heath-grass Occasional 1-5
Non-calcareous grassland.

Molinia caerulea Purple Moor-grass
Frequent, locally comon 1-5
Wet non-calcareous grassland in a range of situations.

Phragmites australis Common Reed 2-4
The most conspicuous component of the fens which fringe, at least in part, the four main lochs at Balnagown, Killean, Kilcheran and Fiart, often forming extensive beds. Rare elsewhere.

SPARGANIACEAE

Sparganium erectum Branched Bur-reed Frequent 1-5
Shallow water of lochs, ponds and water-logged ditches.

S. emersum Unbranched Bur-reed Rare 4
On peaty substrate in shallow water of lochs. Kilcheran Loch and Loch Fiart.

[*S. natans* Least Bur-reed "
In a few localities". (Macvicar, 1899 as *S. minimum*). This record probably relates to *S. emersum*].

LILIACEAE

Narthecium ossifragum Bog Asphodel Frequent 1-5
Peaty flushes and wet heaths.

Hyacinthoides non-scripta Bluebell Common 1-5
Woods, banks and cliff ledges

Allium ursinum Ramsons Common 1-5
Woodland, shady recesses in cliffs and among rock detritus.

**Narcissus pseudo-narcissus* Daffodil
10km square 84 (AAPS, AMcGS et al., 1979). All daffodils seen by the writer outside gardens had obviously been planted and nowhere could they have been regarded as naturalised.

IRIDACEAE

Iris pseudacorus Yellow Iris Common 1-5
Wet ground by ditches and streams, particularly on coasts.

**Crocosmia pottsii x C. aurea = C x crocosmiiflora*
Montbretia 1-4
Rarely established on road and stream-sides outwith garden ground: Port Ramsay; Cameron Cottage; Whin House; Killean Farm; Kilcheran.

ORCHIDACEAE

Epipactis helleborine Broad-leaved Helleborine Very rare 2
Hazel wood at foot of raised beach cliff. Port na Moralachd, scarce.

Listera ovata Common Twayblade Local 1-5
Damp woodland and occasionally in damp grassland in open situations. Plentiful in several places.

Hammarbya paludosa Bog Orchid Very rare 3
Sphagnum bog. Killean Farm. Very difficult to find and not seen every year.

Platanthera chorantha Greater Butterfly-orchid Very rare 1
Damp base-rich grassland. Port Ramsay.

P. bifolia Lesser Butterfly-orchid Rare 1-3
Wet peaty flushes, particularly where broken-up by erosion. Fennachrochan; Killean Farm; south of Sloc a 'Mhuilinn; near Baligrundle (N).

Pseudorchis albida Small-white orchid Very rare 2
Unimproved grassland. Killean Farm.

Gymnadenia conopsea Fragrant Orchid
Widespread and locally plentiful 1-5
Open situations in unimproved calcareous grass land and tolerating a wide range of moisture content. Widespread and locally plentiful.

Coeloglossum viride Frog Orchid Rare 1,5
Damp calcareous grassland. Apparently rare but easily overlooked if populations are small. Unlocalised, BSBI Field Meeting, 1963 (*Proc. BSBI.* 6, 194); Eilean Ramsay; Port Ramsay; Druim Mor, three plants only.

Dactylorhiza fuchsii Common Spotted-orchid Frequent 1-5
Damp grassland on deeper soils.

D. *fuchsii x D. pupurella = D. x venusta* 3
Fen north of Baligrundle (N), det AMcGS.

D. maculata subsp. *ericetorum* Heath Spotted-orchid
Common and locally plentiful 1-5
Damp grassland and heaths but also tolerant of quite basic conditions.

D. incarnata subsp. *incarnata* Early Marsh-orchidFrequent 1-5
Marshes and calcareous flushes. Frequent, particularly on coasts.

D. incarnata subsp. *coccinea* (Plate 3). Rare 2-4
Habitat as for subsp. *incarnata*. Port na Moralachd (AAPS and AMcGS, 1985); Killean Farm; coast near Sean Dun.

D. incarnata subsp. *pulchella* Rare 1,3
Habitat as for subsp. *incarnata*. Tidal island off Port Ramsay; fen north of Baligrundle (N).

D. purpurella Northern Marsh-orchid Occasional 1-5
Marshes and wet grassland.

Orchis mascula Early-purple Orchid Frequent 1-5
Calcareous grassland and ledges of crags.

CHAROPHYTES
Stoneworts

C.D. Preston and N.F. Stewart visited Lismore for two days in July, 1990, and recorded the following Stoneworts. The order is that used by Moore. J.A., 1986.

Only the briefest of notes is given on distribution, including their occurrence in the three major lochs of Balnagown, Kilcheran and Fiart.

Chara vulgaris var. *vulgaris*.
All three lochs and elsewhere.

C. vulgaris var. *longibracteata*.
Not seen in any of the major lochs but occurs elsewhere. Rare in Scotland.

C. vulgaris var. *papillata*.
Lochs Balnagown and Kilcheran. Rare in Scotland.

C. vulgaris var. *contraria*.
Lochs Balnagown and Kilcheran, and elsewhere

C. hispida var. *hispida*
Not seen in any of the major lochs but occurs elsewhere.

C. hispida var. *rudis*.
All three lochs and elsewhere. ("abundant at a depth of 25-35ft" G. West, 1905).

C. globularis var. *virgata*
All three lochs and elsewhere.

C. globularis var. *annulata*
Loch Fiart

C. aspera var. *aspera*
Loch Balnagown and elsewhere.

C. aspera var. *curta*
Lochs Kilcheran and Fiart, and elsewhere. Also recorded at Loch Balnagown by E.C. Wallace, 1949, as *C. desmacantha* (Wats. 2, 212). ("Carpeting the bottom of the lakes from 2 - 20ft". G. West, 1905, as *C. aspera* var. *desmacantha*). Rare in Scotland.

GAZETTEER

Apart from the exceptions marked with an asterisk the place-names used in the text appear on the three Ordnance Survey 1:25,000 Pathfinder maps which cover Lismore. Some of the names appear on the map (Figure 1) and, hopefully, all names used are included in the following gazetteer. The whole of the Lismore area falls within the 100km square NM(17) so this prefix is omitted from all the six figure grid references.

Achadun Bay	806.398	Fiart Farm	806.370
Achadun Castle	804.392	Frackersaig	826.403
Achnacroish	851.409	Glas Dhruim	870.457
Achuaran	878.443	*Hawthorn House	864.437
Achueran House	889.452	Inn Island	899.463
Allt a `Mhuilinn	872.447	Kilcheran	824.388
Argyll Cottage	842.413	Kilcheran Loch	828.394
Bachuil	863.437	Killandrist	856.426
Bagh Clach an Dobhrain	798.372	Killean (Farm)	848.418
Baileouchdarach	872.435	* Killean Loch	846.412
Baleveolan	847.421		
Baligrundle (N)	838.408	Lochan Treshtil	820.379
Baligrundle (S)	834.396	Loch Balnagown	860.426
Balimackillichan	859.437	(L. Baile a `Ghobhainn on map)	
Balnagown	856.419	Loch Fiart	809.376
Balure	865.432	Miller's Port	812.371
Balygrundle	839.401	*Old Schoolhouse	867.440
Barr Mor	815.388	Pladda Island	839.372
Bernera (Island)	795.393	Point	893.461
Brynalen	819.398	Port an Rubha	786.356
Cameron Cottage	851.425	Port Appin	906.454
Castle Coeffin	853.438	Port Kilcheran	826.386
Clachan	861.434	Port na Moralachd	866.450
Creag an Fhithich	834.404	Port nan Leadaig	826.406
Creag Island	835.371	Port Ramsay	882.454
Creag Sgeanach	866.444	Rubha Ban	868.461
Dalnarrow	793.361	Rubha da Uisge	791.356
Druim Mor	792.365	Rubha Fiart	783.357
Dun Chruban	792.360	Salen	832.411
Eilean Droineach	886.461	Sean Dun	845.399
Eilean Dubh	874.421	Sgeir an t-Sailein	838.419
Eilean Loch Oscair	863.455	Sgeir nan Tom	887.477
Eilean Musdile	780.353	Sloc a `Mhuilinn	849.431
Eilean na Caorach	901.468	Slughan	869.454
Eilean na Cloiche	839.383	Stronacroibh	884.449
Eilean nan Gamhna	832.382	Tirefour (Castle)	867.429
Eilean Ramsay	881.459	Tirlaggan	843.410
Fennachrochan	874.451	Whin House	856.428

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The writer would like to thank the farmers of Lismore for their tolerance of his wanderings about their island without which this paper would never have been written. In particular I am grateful to Alison Brooks for making available all the interesting plant records she has made at Killean, and elsewhere on Lismore, and for conducting me round the farm. Miss Lily Stewart of Hawthorn Cottage has also been a source of much valuable information resulting from an association with Lismore going back over sixty years. Both she and Alison found time to look through the draft with the result that some errors have been corrected and some additions made. I am also especially indebted to Dr J.H. Dickson and Mr A. McG. Stirling both of whom not only supplied plant records but also read through the draft and made many helpful comments.

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GLASGOW NATURALIST Vol. 23 Part 1 pp 41-43 (1996)

SCOTTISH INSECT RECORDS FOR 1994

Compiled by E.G. HANCOCK
Art Gallery and Museum, Kelvingrove, Glasgow, G3 8AG

In this list, specific names and reference numbers of the Lepidoptera are as in Bradley & Fletcher (1979) and as these entries are numbered, family names have been omitted. Other insects are as in Kloet & Hincks (1976, 1977).

This is the eleventh year since an annual report on insect records was begun (Christie, 1984). Initially coverage was for butterflies and moths in the Strathclyde region. Gradually this has expanded to include all insect orders from the whole of Scotland. The compiler welcomes any contributions on this basis. It is sometimes the case that what are regarded as common species are under-recorded, especially in the more remote parts of Scotland. Also, information on the status and distribution of insects given in standard texts do not always apply to north of the border.

Because of these differences that can occur, the Scottish Insect Records Index (SIRI) is a useful tool when wishing to assess the status of species in Scotland. This is maintained by the National Museums of Scotland and it can be consulted by appointment at The Royal Museum of Scotland. A leaflet is available as described by Mark Shaw (1987).

LEPIDOPTERA

1545 *Colias croceus* (Geoffroy), Clouded Yellow. Port o'Warren (NX8753), V.C.73, 8/7/94; Moffat (NT0805), V.C.72, 7/94, R&BM.

1553 *Anthocharis cardamines* (L.), Orange Tip. Several new records including: Loch Lomond NNR (NS4387), V.C.99, 13/5/94 JM; Loch Tulla (NN2642), V.C.98, 1994, GK

1555 *Callophrys rubi* (L.), Green Hairstreak. Ochill Hills (NS8398), V.C.87, 30/5/94, JA; Langbank (NS3971), V.C.76, 5/6/94 JW; Barrhill (NS7176), V.C.86, 1994, KF &DS.

1569 *Cupido minimus* (Fuessly), Small Blue. Elliot Links, Dickmonts Den, Seal's Cave, Auchmithie, Heughhead, Friockheim, Boddin, Pitmuies Mill, V.C.90, 1994, MH, this listing includes several newly discovered colonies; Logie Head (NJ5267), V.C.94, 12/6/94, IF.

1573 *Aricia artaxerxes* (Fabr.), Northern Brown Argus. Alva Glen (NS8898), V.C. 87, 31/5/94, JA, larvae.

1574 *Polyommatus icarus* (Rottemberg), Common Blue. Ailsa Craig (NX0299), V.C.75, 7- 29/7/94, BZ, one individual male seen on several occasions.

1590 *Vanessa atalanta* (L.), Red Admiral. Fairly common. Great Cumbrae, V.C. 100, 8/5/94. AJR, early record.

1597 *Inachis io* (L.), Peacock. Bowden (NT5530), V.C.80, 1994, AB, first Borders recorded for several years; Barons Haugh (NS7454), V.C.77, 4/5-19/10/94, RN; Chatelherault Country Park (NS5659) V.C.76, 4/6/94, NR.

1621 *Hipparchia semele* (L.), Grayling. Dellburn Estate (NS7656), V.C.77, 22/7/94, CBH; Pollokshields (NS5763); V.C.77, 8/94, LA.

1628 *Coenonympha tullia* (Müller), Large Heath. Finland Burn (NS4480), V.C.99, 16/7/94; Rosneath Peninsular (NS2482), V.C.99, 18/7/94, JM; Blackhill Mire, Helensburgh (NS3083); V.C.99, 19/7/94, KF.

1629 *Aphantopus hyperantus* (L.), Ringlet. Barons Haugh (NS7654), V.C.77, 3/7/94, CBH.

1954 *Cleorodes lichenaria* (Hufnagel) Loch Caolisport, Kintyre, larvae feeding on lichen on oak tree (NR7274), V.C.101, September 1994, SC.

COLEOPTERA

CARABIDAE

Notiophilus aestuans (Motschulsky). Invernaver NNR, Sutherland, under stone on sandy gravel, V.C.108, 8/8/94, MS.

Blethisa multipunctata (L.). Invernaver NNR, Sutherland, under stone on sandy gravel, V.C.108, 8/8/94, MS.

Dyschirius luedersi Wagner. Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in wet pasture (NX9355), V.C.73, 26/5-28/7/94, SB.

D. politus (Dejean). Mersehead RSPB Reserve, Kirkudbright, pitfall trap in sand dunes (NX9155), V.C.73, 22/4-25/5/94, SB.

Bembidion properans Stephens. Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sand dunes (NX9155), V.C.73, 22/4-25/5/94, SB.

B. quadrimaculatum (L.). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in wet pasture (NX9355), V.C.73, 28/6-28/7/94, SB.

B. schueppeli Dejean. Netherwood Farm, Muirkirk, Ayrshire, pitfall trap in sileage field near running water (NS6628), V.C.75, 4/7-2/8/94. SB.

Pogonus chalceus (Marsham). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sand dunes (NX9155), V.C.73, 28/6-28/7/94, SB.

Calathus cinctus Motschulsky. Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sand dunes (NX9155), V.C.73, SB, first Scottish records of a species previously confused with *C. mollis* and/or *melanocephalus*.

Laemostenus terricola (Herbst). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sand dunes (NX9155), V.C.73, 22/4-25/5; 28/6-28/7/94, SB.

Agonum viduum (Panzer). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in wet pasture (NX9355), V.C.73, 28/6-28/7/94, SB.

Amara apricaria (Paykull). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sandy arable land (NX9356), V.C.73, 22/4-28/7/94, SB.

A. fulva (Müller). Mersehead RSPB Reserve, Kirkcudbright, pitfall trap in sandy arable land (NX9356), V.C.73, 22/4-25/5; 28/6-4/10/94, SB; Tyne Mouth, East Lothian, under stone on sand spit, V.C.82, MS, (RDB: Notable B species).

DYTISCIDAE

Hydroporus longicornis Sharp. Rest and be Thankful, Argyll, abundant in watershed mire (NN229071), V.C.98, 4/12/94, GNF.

H. obsoletus Aubé. Linlithgow Loch, West Lothian (NT007778), V.C.84, 10/4/94, GNF.

Agabus melanarius Aubé. Ardentinny, Argyll, woodland pool (NS174895), V.C.98, 11/9/9/94, GNF.

Acilius canalicalatus (Nicolai). Knockdaw Hill, Ayrshire, frequent in well eyes in fen (NX1488), V.C.73, 11/9/94, GNF, new record for the vice-county.

HYDROPHILIDAE

Chaetarthria seminulum (Herbst). Armadale Gorge, Sutherland, in flush near burn, V.C.108, 9/8/94, MS.

HYDRAENIDAE

Ochthebius auriculatus Rey. Mersehead, Kirkcudbright, pitfall trap in dunes, V.C.73, 25/5/94, SB & MS; West Barns, East Lothian, small tidal pools, V.C.82, 5/9/94, MS.

O. marinus (Paykull). West Barns, East Lothian, in company of above species, V.C.82, 5/9/94, MS.

LEIODIDAE

Agathidium marginatum Sturm. Mersehead, Kirkcudbright, pitfall trap in dunes, V.C.73, 25/5/94, SB & MS.

Choleva glauca Britten. Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS; Northouse Burn, Roxburghshire, under stone on shingle, V.C.80, 7/6/94, MS.

Catops longulus Kellner. Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS.

SILPHIDAE

Aclypea opaca (L.). Tyne Mouth, East Lothian, under stone on sand spit, V.C.82, 10/5/94, R. Anderson (per MS).

STAPHYLINIDAE

Lathrobium ripicola Czwalina. Mersehead, Kirkudbright, pitfall trap in stubble field, V.C.73, 25/5/94, SB & MS, apparently new to southwest Scotland.

Erichsonius signaticornis (Mulsant & Rey). Northouse Burn, Roxburghshire, sifted from moss, V.C.80, 18, 18/4/94, MS.

Gabrius bishopi Sharp. Mersehead, Kirkcudbright, pitfall trap in grass and stubble fields, V.C.73, 25/5/94, SB & MS.

G. keysianus Sharp. Mersehead, Kirkcudbright, pitfall trap in dunes, V.C.73, 25/5/94, SB & MS, apparently new to southwest Scotland.

Quedius auriconius Kiesenwetter. Mersehead, Kirkcudbright, pitfall trap in dunes, V.C.73, 25/5/94, SB & MS.

Mycetoporus piceolus Rey. Mersehead, Kirkcudbright, pitfall trap in dunes, V.C.73, 25/5/94, SB & MS, apparently new to southwest Scotland.

Atheta heymesi Hubenthal. Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS. This species was recently discovered in Perthshire as being new to the British Isles (Lyszkowski, 1992) and the only other record appears to be from Ayrshire (Sinclair, 1992).

Oxypoda spectabilis Maerkel. Northouse Burn, Roxburghshire, pitfall trap, V.C.80, 28/6/94, MS.

Aleochara brevipennis Gravenhorst. Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS.

A. ruficornis Gravenhorst. Northouse Burn, Roxburghshire, pitfall trap, V.C.80, 28/6/94, MS.

SCARABAEIDAE

Aphodius distinctus (Muller). Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS, apparently new to southwest Scotland.

CLERIDAE

Thanasimus formicarius (L.). Dundonald, Ayrshire, probably in association with freshly cut wood for pallets, V.C.75, 15/9/94, R. Beretti (per GNF).

COCCINELLIDAE

Aphidecta obiterata (L.). Vale of Leven, Dumbarton, among Sitka spruce and Scots pine, V.C.99, 22/9/94, KF.

Neomysia oblongoguttata (L.). Old Luss Road Plantation, Helensburgh, Dumbarton, apparently in an hibernating posture (NS314836), V.C.99, 27/11/94, KF.

CHRYSOMELIDAE

Longitarsus brunneus (Duftschmidt). Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS.

CURCULIONIDAE

Tropiphorus obtusus (Bonsdorff). Mersehead, Kirkcudbright, pitfall trap in field, V.C.73, 25/5/94, SB & MS.

Grypus equiseti (Fabr.). Mersehead, Kirkcudbright, pitfall trap in grass and stubble fields, V.C.73, 25/5/94, SB & MS.

Litodactylus leucogaster (Marsham). Wishaw, Lanarkshire, in a quarry pond, V.C.77, 8/5/94, MS.

DIPTERA

TIPULIDAE

Tipula variicornis Schummel. St Kilda, The Tunnel (NA088008), V.C.110, 18/5/94, RH.

T. alpium Bergroth. St Kilda, Factor's House (NF102993), V.C.110, 18/5/94, RH.

T. rufina Meigen. St Kilda, Ablution Block, (NF102993), V.C.110, 18/5/94, RH.

T. subcunctans Alexander (=*czizeki* de Jong). Sandford, Strathaven V.C.77, 6/10/94, EGH.

LIMONIIDAE

Limonia nubeculosa Meigen. St Kilda, near summit of Oiseval (NF108992), 20/5/94; The Tunnel (NA088008), V.C.110, 18/5/94, RH.

BIBIONIDAE

Dilophus femoratus Meigen. St Kilda, Factor's House (NF102993), V.C.110, 18/5/94, RH.

EMPIDIDAE

Clinocera stagnalis (Haliday). St Kilda, Factor's House (NF102993), V.C.110, 18/5/94, RH.

SYRPHIDAE

Brachypalpoides lenta (Mg.). Auchincruive, Ayrshire, V.C.75, June 1994, GNF.

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CADDIS FLIES (TRICHOPTERA) FROM FETLAR, SHETLAND

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INTRODUCTION

There have been no recent surveys of caddis flies in Shetland. The last two surveys were carried out more than twenty years ago (Jones and Mortimer, 1974; Crichton, 1971; Crichton *et al*, 1978) and none include the Island of Fetlar, the most easterly of the Shetland Isles. The present survey was conducted as part of a study of the breeding requirements of the Red-necked Phalarope, caddis flies being a known food item of this species (Cramp, 1983).

The objectives of the study were to monitor the changes in the numbers of caddis flies with time, and assess which variables in the structure of mire pools explain the variation in the number of caddis flies.

METHODS

The caddis flies were collected from emergence traps with a basal area of 0.5m x 0.5m and height of 0.25m, situated at the edge of 5 pools in each of the 4 mires surveyed. These emergence traps, based on the design of Owen (1989), were white pyramidal netting tents with guys connected to each corner of the tent. The guys were threaded onto bamboo canes set at each corner. The collecting head, situated at the top edge of the tent, was made from a short length of clear perspex tubing, heated and bent at the centre to an angle of about 60° with a lip below. This was superglued to a cap of a universal tube. A second cap was glued and taped back to back with the first, and a hole was burnt through the middle of the caps. A universal tube, half full of 70% ethanol, was then screwed onto the cap (O'Brien, in prep.).

The samples were collected weekly from June (week 22) to early August (week 31) 1993 and from June (week 23) to early July (week 28) 1994, sorted from the rest of the invertebrates caught and stored in 70% ethanol. The caddis flies collected in 1993 were sent to Liverpool Museum and identified by Dr Ian Wallace, and 1994 caddies flies were identified at the University of Paisley with the aid of Macan (1973).

Measurements of the structure of the mire pools within the emergence traps were collected by Mr Mark O'Brien (personal communication). These were water depth, sediment depth, vegetation height, % open water and the primary and secondary plant species, i.e. the species of plants most in abundance within the emergence traps.

RESULTS

A total of 237 caddis flies of the following 8 species were caught (numbers of each in brackets): *Plectrocnemia conspersa* (Curtis) (44), *Mystacides azurea* (Linnaeus) (50), *Agrypnia varia* (Fabricus) (6), *Limnephilus incisus* (Curtis) (85), *Limnephilus affinis* (Curtis) (44), *Limnephilus lunatus* (Curtis) (1), *Limnephilus auricule* (Curtis) (3) and *Oxyethira falcata* (Morton) (4).

Fig. 1. Weekly numbers of (a) all caddis flies, (b) *P. conspersa*, (c) *M. azurea*, and (d) *L. incisus*.
Filled columns, 1993; open columns, 1994.

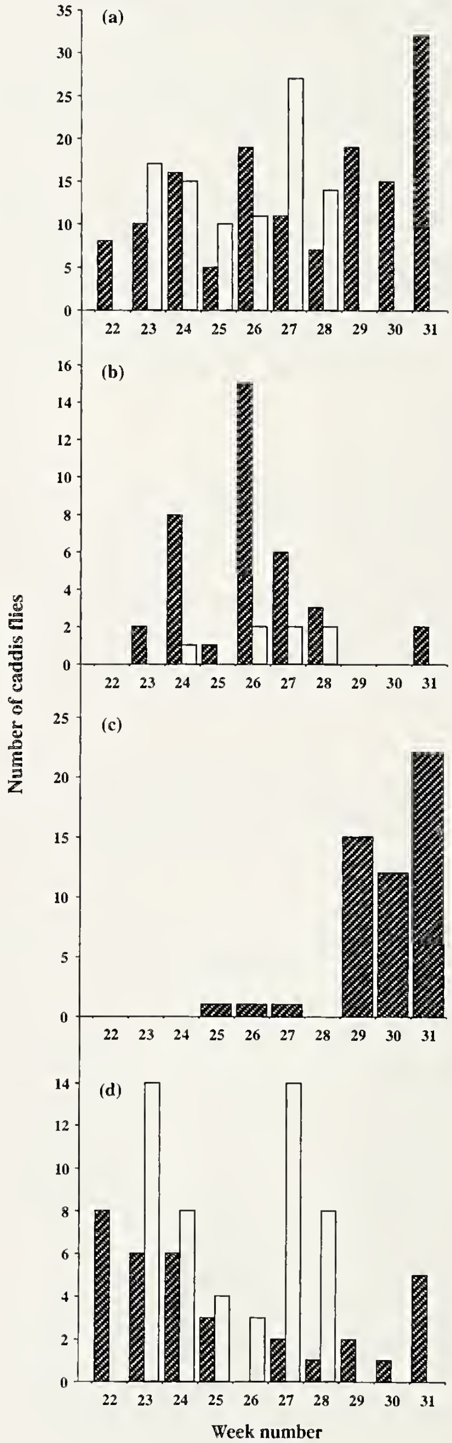

Fig. 2 Weekly numbers of *L. affinis*

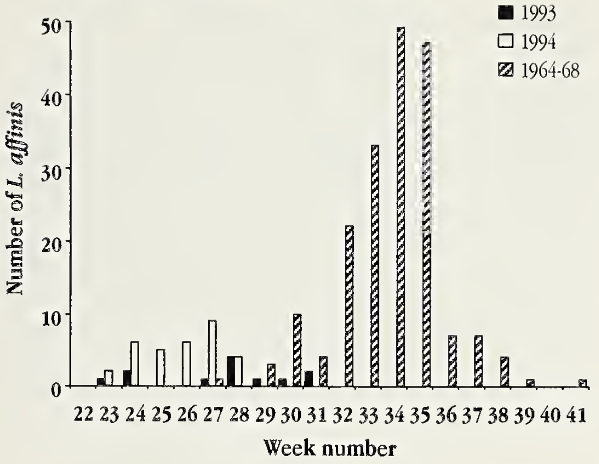

Table 1. Correlation of variables (structures of the mire pools which include abundance of the plant species) with the total number of caddis flies (all species).

Variable	Correlations of variables with numbers of caddis flies (+ Probability (P))
Carex rostrata	-0.586 (<0.01)
Carex nigra	0.302 (>0.05)
Potamogeton polgonifolius	-0.132 (>0.10)
Potentilla palustris	0.068 (>0.10)
Juncus bulbosus	0.385 (<0.05)
Menyanthes trifoliata	0.111 (>0.10)
Eleocharis palaestris	0.256 (>0.10)
Equisetum palustre	0.111 (>0.10)
Juncus articulatus	0.065 (>0.10)
Water depth (m)*	-0.243 (>0.10)
Sediment depth (m)	0.413 (<0.05)
Vegetation height (m)	-0.305 (>0.05)
% open water*	-0.214 (>0.10)

NB - total number of caddis flies and * variables were logged to normalise the data for analysis.

Table 2. Stepwise Multiple Regression analysis of variables with number of caddis flies.

Variable	t-ratio	Probability (P)
Carex rostrata	-3.86	0.001
Sediment depth	3.71	0.002
Water depth	-2.62	0.018
Overall-fit	10.75*	0.000
* = F statistic	(R^2=0.606)	

Table 3. Correlation of variables (structures of the mire pools which include abundance of the plant species) with the number of *L. incisus*

Variable	Correlation of variables with nos. of *L. incisus* (+ Probability (P))	
Carex rostrata	-0.097	>0.10
Carex nigra	0.301	>0.05
Potamogeton polgonifolius	-0.006	>0.10
Potentilla palustris	0.449	<0.025
Juncus bulbosus	-0.050	>0.10
Menyanthes trifoliata	0.171	>0.10
Eleocharis palaestris	0.012	>0.10
Equisetum palustre	-0.185	>0.10
Juncus articulatus	-0.185	>0.10
Water depth (m)*	-0.496	<0.025
Sediment depth	0.150	>0.10
Vegetation height (m)	0.071	>0.10
% open water*	-0.406	<0.05

NB - *L. incisus* and * variables were logged to normalise the data for analysis.

Table 4. Stepwise Multiple Regression analysis of variables with numbers of *L. incisus*

Variable	t-ratio	Probability (P)
Water depth	-4.17	0.001
Potentilla palustris	3.36	0.004
Sediment depth	2.46	0.026
Overall fit	9.06*	0.001
* = F statistic	(R^2=0.56)	

The maximum number of caddis flies (Fig. 1a.) caught in 1993 was 31 in week 31 and in 1994, 27, in week 27. Except for week 24, fewer caddis flies were caught throughout 1993 than in 1994. *P. conspersa* (Fib. 1b.) was caught in smaller numbers in 1994 than in 1993, with the maximum number caught being in week 26, 1993. *M. azurea* (Fig. 1c.) was only caught in 1993 with the maximum number caught in week 31. The maximum number of *L. incisus* (Fig. 1d.) caught in 1993 was 8, in week 22, and in 1994 was 14, in weeks 23 and 27. This species was found in smaller numbers throughout 1993 than in 1994. *L. affinis* (Fig. 2.) was caught earlier in this survey of caddis flies than in the 1964-1968 survey of Scotland (Crichton, 1971). In this survey *L. affinis* was found in lower numbers in each week of the study period of 1993 than in 1994. The maximum number caught was 9 in week 27, 1993.

Table 1. shows that when all the variables from the structure of the mire pools were correlated with the number of caddis flies the only variables to correlate significantly (i.e. $P<0.05$) were the abundance of *Carex rostrata, Juncus bulbosus* and sediment depth.

Stepwise Multiple Regression analysis was used to assess which group of variables explained the most variation in the number of caddis flies. The group of variables produced by this analysis was *Carex rostrata,* sediment depth and water depth with 60.6% of the variation explained (adjusted R^2 = 0.606 - see Table 2.). The analysis suggests that when *C. rostrata* was an abundant plant species and water depth increases the number of caddis flies decreases and as sediment depth increases, so too does the number of caddis flies.

Table 3, shows that when all the variables from the structure of mire pools were correlated with the numbers of *L. incisus* the only variables to correlate significantly (i.e. $P < 0.05$) were the abundance of *Potentilla palustris,* water depth and sediment depth.

Stepwise Multiple Regression analysis was used to assess which group of variables explained the most variation in the numbers of *L. incisus.* The group of variables given by this analysis was water depth, *Potentilla palustris* and sediment depth with 56% of the variation explained (adjusted R^2 = 0.56 - see Table 3.). The analysis suggests that as water depth increases the number of caddis flies decreases, and when *P. palustris* was an abundant plant species and sediment depth increases so too does the number of caddis flies.

DISCUSSION

In the previous surveys carried out in the Shetland Isles (Briggs, 1884; Carpenter, 1950; Evans, 1915, 1916; Grimshaw, 1906; Jones & Mortimer, 1974; King, 1890, 1896; McLachlan, 1884 a & b; Crichton, 1971) *Oxyethira falcata* was not recorded. Four *O. falcata* were found in this survey, all in one pool in 1993. This species was not found in 1994.

In this survey the most common caddis fly was *Limnephilus incisus*. By contrast the Rothamsted Insect Survey (Crichton, 1971) failed to catch *L. incisus* in Sandwich, Shetland, or any part of Scotland. The reason for this could be that, in the Rothamsted Insect Survey, light traps were used, thus limiting the capture to night flying caddis flies, whereas the emergence traps set up in the mire pools of Fetlar would capture caddis flies emerging from the pools at any time of the day.

In the first week of 1993 and 1994 in this survey the most numerous species was *L. incisus*, suggesting that this is the earliest of the caddis flies to emerge. Surveys starting earlier in the year would obviously be required to prove this.

In the Rothamsted Insect Survey (Crichton, 1971), *L. affinis* was not collected in Scotland until early July, whereas in this survey they were collected from early June. Flight periods of species which have larvae feeding as shredders, i.e. most of the limnephilids, are longer in southern Norway than in southern England (Otto, 1981). Therefore, since southern Norway and Fetlar, Shetland, are at a similar latitude there is a possibility that *L. affinis* could be collected for longer periods in Fetlar than further south in the British Isles. In Iceland, this species has a shorter flight period in the central Highlands than in the Lowlands (Gislason, 1978; Gislason *et al.*, 1990). Therefore, altitude may be an important factor in the flight period of this species.

The maximum number of *P. conspersa* were caught in the Faroes in late July (Anderson *et al.*, 1992) and in Scotland (Crichton, 1971) in late July to early August. In this survey the maximum number of *P. conspersa* were caught in the last week of June 1993 with none in late July and only 2 caught in the first week of August 1993.

In the 1994 survey in Fetlar the number of species was lower than in 1993 with neither *Mystacides azurea*, *Limnephilus lunatus* nor *Oxyethira falcata* recorded with fewer *Plectrocnemia conspersa*. By comparison, *Limnephilus incisus* and *Limnephilus affinis* were more numerous in 1994.

The group of variables which explains best the variation in the number of caddis flies is the abundance of *Carex rostrata*, sediment depth and water depth. The highest number of caddis flies - 48 (consisting mainly of *P. conspersa*) - were found in the pool with the deepest sediments (1.6m). This would be expected since a significant prey item of *P. conspersa* is chironomid larvae (Townsend & Hildrew, 1978), many species of which burrow in sediment (Fitter & Manuer, 1986). A negative correlation between the abundance of *C. rostrata* and caddis flies would not be expected if caddis flies were important in the diet of the Red-necked Phalarope. Batten *et al.* (1990) noted that during the breeding season of the Red-necked Phalarope they prefer to feed amongst emergent vegetation, especially tall and sparse *C. rostrata*.

The group of variables which explains best the variation in the number of *L. incisus* is water depth, abundance of *Potentilla palustris* and sediment depth. Water depth is an important variable since Hicken (1967) noted that *L. incisus* is found in rushy ditches in which there is not much water. Also, Wallace *et al.* (1990) noted that they are found in tussocky margins of pools, lakes and slow-flowing ditches which contract or dry out in summer. Therefore, *L. incisus* seems to require shallow water habitat. *Potentilla palustris*, another variable in the group, is commonly found in shallow water (Arlott *et al.*, 1981). Since both this plant and *L. incisus* inhabit shallow water, a positive correlation between them would be expected.

ACKNOWLEDGMENTS

I wish to thank Dr Martin Jones of Manchester Metropolitan University for his advice on the analysis of the data and the supervision of this paper, Dr Alan Fielding for his advice on the analysis of the data and Mr Mark O'Brien of the RSPB for his guidance and support during the months on Fetlar in 1993 and 1994 and for allowing me to use the data on the structure of the mire pools of Fetlar. I am grateful to Dr Joy Matthews and Dr Roger McLean of the University of Paisley for thier advice in the earlier part of the project, to Dr Ian Wallace of Liverpool Museum for kindly identifying caddis flies collected in 1993, and to the Biology Department of the University of Paisley for their facilities. The 1994 part of the project was funded partially by the Glasgow Natural History Society (Lloyd-Binns bequest). Their aid was much appreciated.

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AQUATIC HETEROPTERA ON ARRAN

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INTRODUCTION

In the course of mapping the distribution of aquatic bugs in Scotland, the author has examined collections in museums. The Royal Museum of Scotland, Chambers Street, Edinburgh holds specimens from Arran, mainly collected by A.R. Waterston in 1937 but with a few later specimens dated 1958. A visit to the island at the end of May 1995 provided an opportunity to find out how many of the species recorded at the earlier dates were still present. Spelling of scientific names is in accordance with Savage (1989) but the ordering of names in lists follows the Biological Records Centre card for aquatic Heteroptera (6433, Jan. 1984). Records are summarised in Table 1. Because Ordnance Survey grid references are seldom associated with location data attached to older museum specimens, and location data often adequate to place specimens within a 10 x 10 km square only, strict site specific comparisons are often problematical between older and contemporary records, except at the 10 x 10 km dimension. This is true of the Arran material, hence the fact that for some 10 x 10 km squares, several locations are given in Table 1.

NOTES ON SPECIES

VELIIDAE

Velia caprai Tamanini is common throughout the island in burns and, less frequently, lochans.

GERRIDAE

Gerris argentatus Schummel is a new record for Scotland, confirmed by A.A. Savage. It would be comforting if more specimens were to be found in future than the single male taken by the author.

Gerris costai (Herrich-Schaffer) has been recorded in more locations on Arran than shown in Table 1. It was re-found in 1995 in a shallow peat pool near the 200 metres contour.

Gerris lacustris (Linnaeus) is a common skater of lowland standing waters and is also common in central and southern Arran.

Gerris thoracicus Schummel is not so widely distributed as the former species in Scotland but can be abundant in suitable locations, for example on Arran a narrow ditch crossing Machrie Golf course.

NEPIDAE

Nepa cinerea Linnaeus was recorded in 1995 by a single immature specimen in the same thickly vegetated ditch at Machrie as *G.thoracicus*.

NOTONECTIDAE

Notonecta glauca Linnaeus was found at four locations and is probably more widespread on Arran.

Notonecta obliqua Gallen, however, is less common in Scotland generally and on Arran was found at two locations only, one being the eastern of the two Beinn Lochain pools, in upland moorland.

CORIXIDAE

Cymatia bonsdorffi (Sahlberg) was found sparsely at two locations only.

Glaenocorisa propinqua (Fieber) was recorded by Waterston in 1937 from a "pool near Beinn Lochain, near Dougarie". There are two pools just to the north of this hill (summit 228m): the western shallower pool with surrounding boggy area extending across the eastings NR90 grid line (hence the two grid references in Table 1). In 1995, however, this species was found in neither pool but it was found when looking for *Arctocorisa carinata* in Lochan a`Mhill.

Corixa panzeri (Fieber) was recorded by Waterston in the Dougarie/Machrie area in 1937 but not found by the author.

Corixa punctata (Illiger) was also recorded by Waterston but his specimens renamed by A.A. Savage as *C. iberica*. Nevertheless the species does exist on Arran, the author recording it at two locations near Lagg.

Corixa iberica Jansson was not known to exist in Scotland until 1986 (Savage 1989), and Savage's map of the Scottish distribution of this species, along with *C. punctata* (Fig. 71, *ibid)* shows three records for *C. iberica* on Arran, included in Table 1. In 1995 the author found it in one of two old upland farm reservoirs near Lagg, with *C. punctata* in the other reservoir.

Hesperocorixa spp: the three species of this genus found in Scotland, *H. castanea* (Thomson), *H. linnaei* (Fieber) and *H. sahlbergi* (Fieber), (there is a single record for a fourth species, in Dumfriesshire, the permanence of which as a viable population has yet to be established) are all recorded for Arran. Surprisingly, the commonest of the three, *H. sahlbergi,* was not previously recorded by Waterston.

Arctocorisa carinata (Sahlberg), was recorded by Waterston in 1937 and by the author in Lochan a` Mhill, which is, of course, not proof that this population has existed there for over half a century, but a hopeful indicator nonetheless that some old records are still valid. Lochan a, Mhill is a typical

Species	Location 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Velia caprai Tamanini	O			O		+	+									O				O		O
Gerris argentatus Schummel											O											
Gerris costai (Herrich-Schaffer)		O			+																	
Gerris lacustris (Linnaeus)									O	O	O	O		O		O		O		O		
Gerris thoracicus Schummel															O			O				
Nepa cinerea Linnaeus															O							
Notonecta glauca Linnaeus								O										O		O	O	
Notonecta obliqua Gallen											O										O	
Cymatia bonsdorffi (Sahlberg)																				O	O	
Glaenorcorisa propinqua (Fieber)			O							+												
Corixa panzeri (Fieber)													+									
Corixa punctata (Illiger)																		O		O		
Corixa iberica Jansson					+								+						+		O	
Hesperocorixa castanea (Thomson)											O		+								O	
Hesperocorixa linnaei (Fieber)													+							O		
Hesperocorixa sahlbergi (Fieber)											O	O										
Arctocorisa carinata (Sahlberg)			+O																			
Callicorixa praeusta (Fieber)																	O				O	
Callicorixa wollastoni (Douglas & Scott)			O										+									
Sigara distincta (Fieber)													+				O	O		O		
Sigara dorsalis (Leach)													+	O				O				
Sigara falleni (Fieber)													+									
Sigara fossarum (Leach)																	O	O				
Sigara lateralis (Leach)																			+			
Sigara nigrolineata (Fieber)									O	O	O	O								O		
Sigara scotti (Douglas & Scott)			O								O		+	O							O	
Sigara venusta (Douglas & Scott)													+									

Table 1 Summary of aquatic Heteroptera records on Arran + = old record; **O** = 1995 record

Key to Locations:

1	Allt nan Eireannach	NR911488	9	Beinn Lochain pools	NR899373	16	Machrie golf course, north end	NR894344
2	Creagan nan Gobhar	NR913485	10	Beinn Lochain pools	NR901373	17	farm pond, Corriecravie	NR912240
3	Lochan a' Mhill	NR913477	11	String road lochan	NR955355	18	remnant pond, Lagg	NR942217
4	Lochan a' Mhill burn	NR913477	12	Brodick Castle garden	NS017377	19	Lagg area	NR92
5	North Arran	NR94	13	Dougarie, & Machrie golf course	NR8837	20	Bourtree Bank reservoir	NR949222
6	Glen Diomhan burn	NR927467	14	pond near beach, Machrie	NR893339	21	Bennacarrigan reservoir	NR946228
7	Corrie	NS0243	15	Machrie golf course	NR894339	22	burn, Dippen	NS044240
8	Beinn Lochain pools	NR903374						

upland loch of about 1 ha. mostly edged by boulders and with patches of dense submerged vegetation in its deeper parts. According to Southwood and Leston (1956) *A. carinata* is "found throughout Scotland above 1,000 feet". Lochan a, Mhill is less than 1,000 feet but as this species has been recorded at much lower elevations in Shetland (P.S. Maitland, *pers. comm.).* the slightly lower height at this location is not significant.

Callicorixa spp: both *C. praeusta* and *C. wollastoni* were recorded by Waterston and the author.

Sigara spp: eight species have been recorded by either Waterston or the author, or by both, as shown in Table 1, and it is open to speculation why, for example, *S. falleni* (Fieber), which is common in Scotland and recorded by Waterston, was not also recorded by the author in 1995, or conversely, why Waterston did not record *S. nigrolineata* (Fieber), found by the author at four locations. This may be explained by changes in the nature, quantity and quality of Arran's lowland ponds since the 1930s. For example, there were probably more water bodies in the Machrie area fifty years ago than now, and at Lagg and Dippen the author found remnants only of what are shown on the 1:25000 South Arran map as ponds.

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THE SEASONAL OCCURRENCE OF SOME PROMINENT ZOOPLANKTON SPECIES IN ROUGH FIRTH. III. DECAPOD LARVAE.

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INTRODUCTION

The Decapoda include such well known animals as lobsters, crabs, shrimps and prawns whose early stages of development are spent as larvae in the on-shore and off-shore plankton. The fertilised egg gives rise to a special type of larva known as a zoea, some examples of which are shown in Figs. 1 & 2.

The zoea of *Carcinus maenas*, the common shore crab, is very distinctive (Fig. 1a). Its prominent eyes, almost spherical carapace with two conspicuous spines and an abdomen of five or six segments which ends in a forked telson, are typical of the Brachyura or true crabs. Two pairs of maxillipedes are used for swimming, while the long spines help to give direction and to support the animal near the surface. The spines may also have a protective value against predators. In other Brachyura two additional lateral spines may be present, as in Polybiinae larvae, the dorsal spine may be missing, as in the larvae of *Pinnotheres pisum* (Fig. 1c) or there may be no spines at all. In the latter case such larvae live nearer the bottom (Lebour, 1928a).

The zoea of *Carcinus* moults four times and then becomes a megalopa (the name refers to the relatively large eyes) which is much more crab-like with its five pairs of legs (Fib. 1b). However, the abdomen is not curved under the body but extends horizontally and the larva now swims with its pleopods, the maxillipedes being used as mouthparts.

In contrast the zoeae of the Anomura (squat lobsters, porcelain crabs and hermit crabs), Thalassinidea (burrowing shrimps) (Fig. 2a-d) and the Caridea (true shrimps and prawns) (Fig. 2e) have a carapace which is considerably longer than its breadth or depth. Porcelain crab larvae are remarkable for the great length of the rostral and carapace spines while the aptly named trachelifer larva of *Jaxea* (a burrowing shrimp) has a "neck" separating the head from the mouth (Fig. 2d). These features increase the surface area significantly.

METHODS

The method of collection was reported by Skinner (1995). Temporary preparations of the appendages, carapace, abdomen and telson were mounted in water or dilute glycerine. Permanent preparations were made using polyvinyl lactophenol as the mountant. Nomenclature for Brachyura and Thalassinidea is that of Ingle (1992) and for Anomura and Caridea is that of Williamson (1957a, b and 1960).

RESULTS AND DISCUSSION

A total of 21 species was identified. The swimming crabs, however, were identified to sub-family level only.

Three groups may be recognised, based on mean number of larvae per 15 min. haul or total number caught, which may be categorised roughly as abundant, common and scarce (Table 1, Groups I, II, III). Ten of the thirteen species in the latter group occurred in one season only, whereas in the other two groups all nine species occurred in both seasons.

In groups I and II, where reasonably large numbers were caught, a high proportion of larvae were ZI stages (ranging from 33.7% *(Pinnotheres)* to 83.9% *(Corystes);* and even in group III ZI stages were common. This suggests the littoral and sub-littoral population of adults from which the larvae originated must have been quite near. As Rough Firth dries out after every tide more than one site must be involved and this may be one reason underlying the very wide range of numbers caught. Although found at the surface, the larvae of *Pinnotheres* tend to sink to the bottom where they feed and so their behaviour is different from that of the others. This may have resulted in this species being under represented.

Carcinus and *Crangon* are found throughout Rough Firth but only small young shrimps are present. Older specimens are found east of Heston, in the Solway, where they are fished commercially. Their habit of gathering in large numbers in the various channels may account partly for the high number of larvae caught.

Lower numbers of larvae may reflect lower numbers of adults and this may account for the absence of six species (marked ** in Table 1) from the fauna list for the Solway Firth (Perkins, 1971). Other possible reasons are that adults are common but more widely dispersed; the spawning season may be ill defined; fewer eggs may be produced; predation may be selective, and even though sampling was on a weekly basis, because of patchiness in the plankton, species could be under represented.

The seasonal occurrence is summarised in Fig. 3 and the capture dates of single specimens (two in the case of *Upogebia)* are shown in Table 1. The summer and autumn months provided the greatest variety of species. Fewer occurred in spring, although even in mid winter occasional larvae of *Crangon* and *Carcinus* could be found and by late February *Pagurus* larvae had started to appear.

The period during which larvae of a given species may be present appeared to vary widely. Thus, *Hyas*, and *Callianassa, Pinnotheres, Jaxea* and *Palaemon* larvae were present for only three months: *Macropodia, Corystes* and *Porcellana* for four months; *Pisidia* for five months; *Pagurus* and Polybiinae for six months and *Carcinus* and *Crangon* for eleven and twelve months respectively. However, it is possible that the Polybiinae consisted of two species, in which case there would be two shorter periods of occurrence.

The results for *Crangon* are unique in that they suggest there are two peaks of abundance: a small one in June and a much larger one in September.

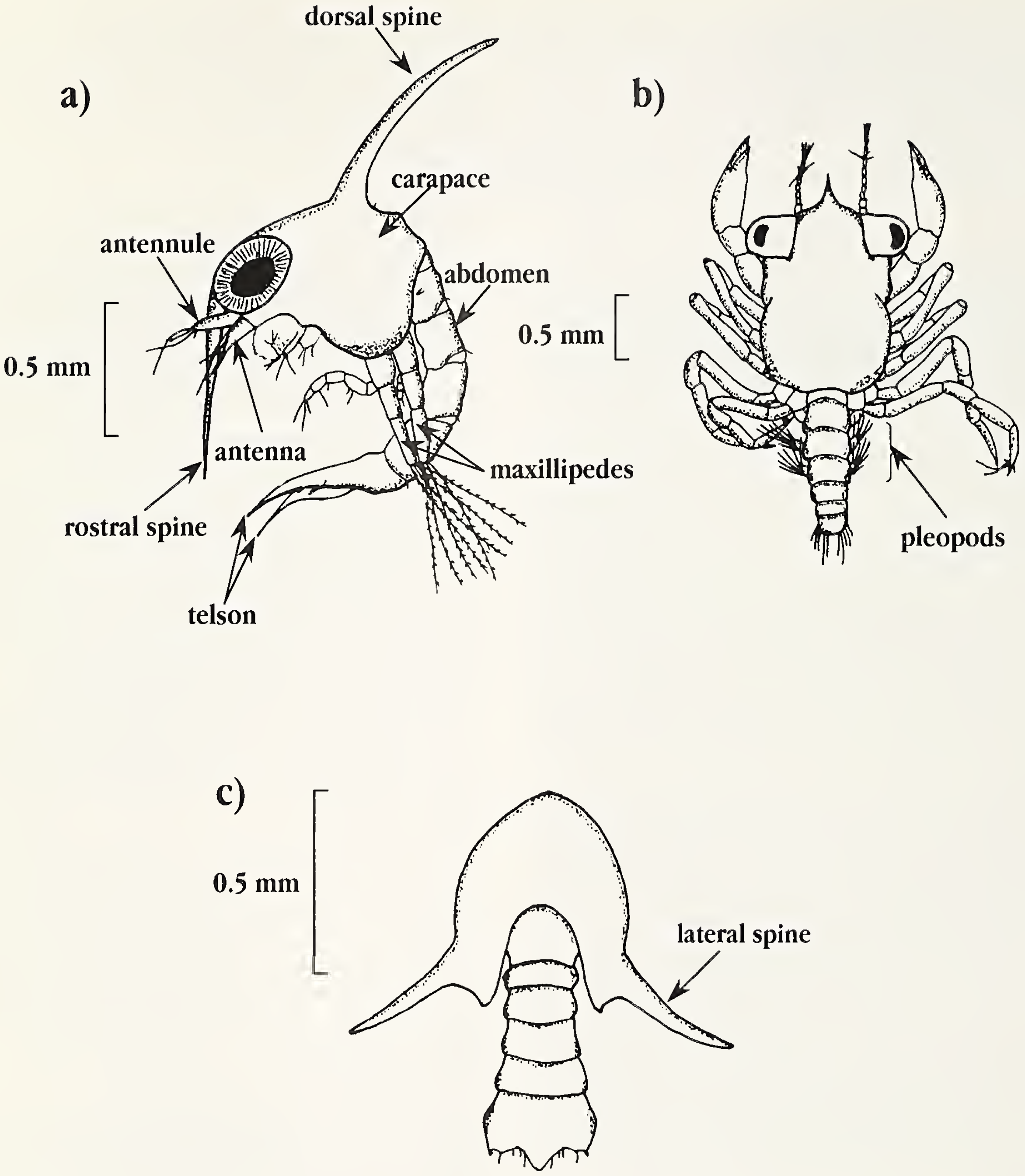

Figure 1

a) *Carcinus maenas,* Zoea I

b) *Carcinus maenas,* Megalopa

c) *Pinnotheres pisum,* Zoea I (from behind)

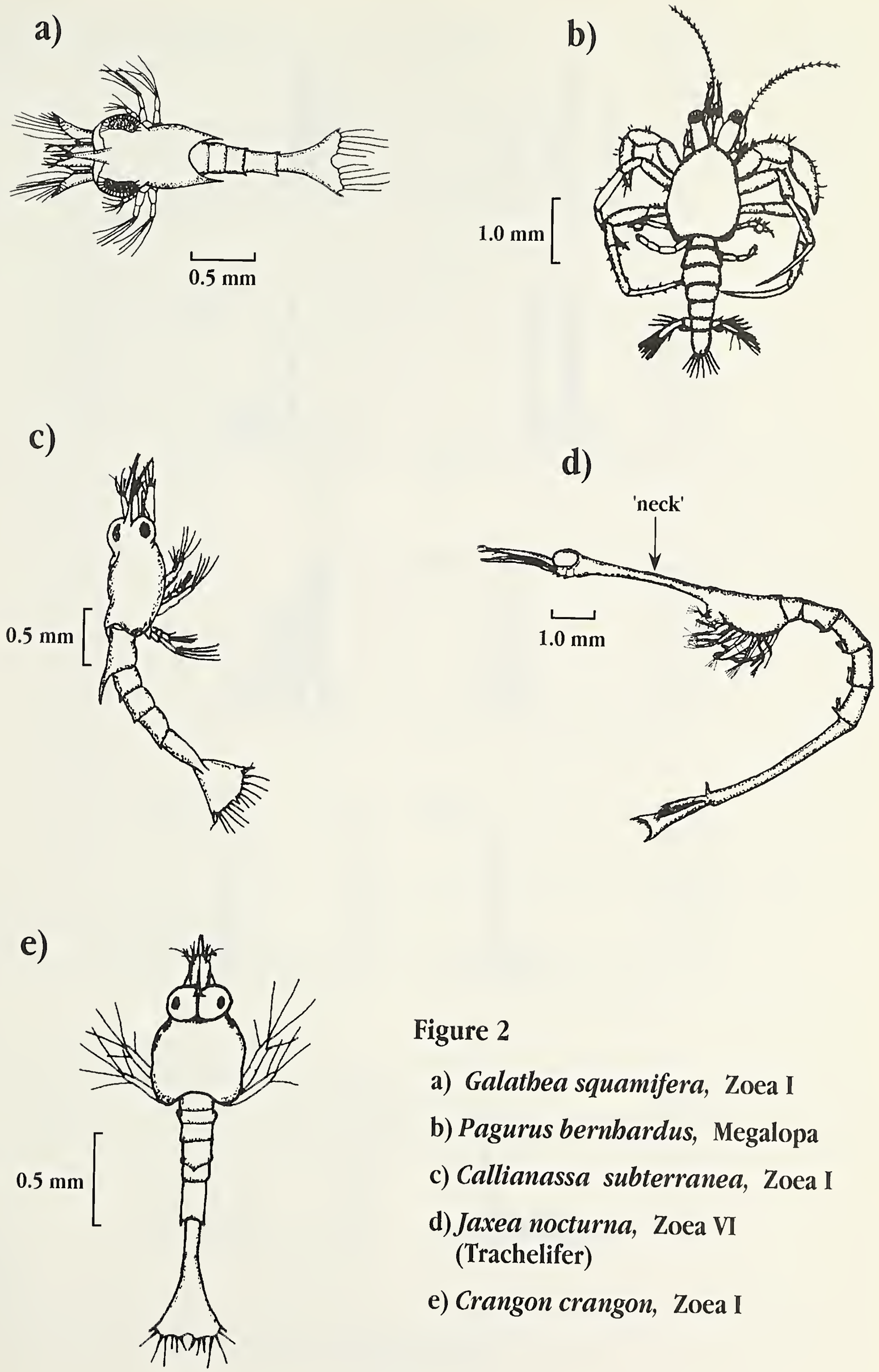

Figure 2

a) *Galathea squamifera,* Zoea I

b) *Pagurus bernhardus,* Megalopa

c) *Callianassa subterranea,* Zoea I

d) *Jaxea nocturna,* Zoea VI (Trachelifer)

e) *Crangon crangon,* Zoea I

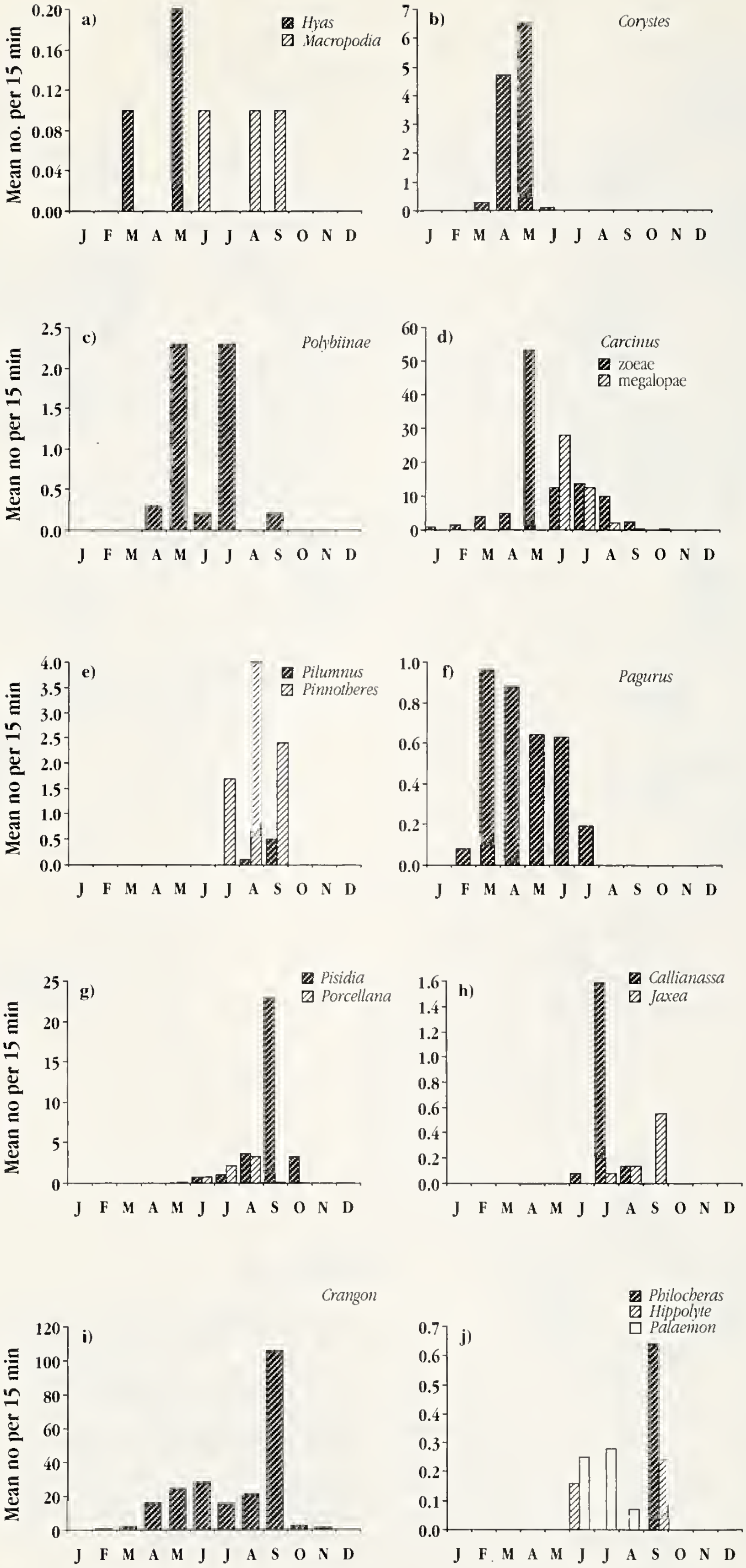

Figure 3. Seasonal occurrences (by month) of decapod larvae in Rough Firth

Table 1. Decapod larvae recorded from Rough Firth. Species arranged in order of decreasing abundance. Z1 = first zoel stage, %Z1 = % of numbers caught which were Z1 stages.

Group	Species List	Mean No. / 15 min.	No. of seasons	Nos . caught	No. Z1	% Z1
I	*Crangon crangon* (L)	16.87	2	2692	1711	63.6
	Carcinus maenas (L)	12	2	1793	1011	56.4
II	*Pisidia longicornis* (L)	6.27	2	386	313	81.1
	Corystes cassivelanus (Pennant)	2.93	2	137	115	83.9
	Pinnotheres pisum (L)	2.7	2	104	35	33.7
	Porcellana platycheles (Pennant)	1.02	2	83	49	59
	Subfamily *Polybiinae* Ortman	0.85	2	57	46	80.7
	Callianassa subterranea (Montagu)**	0.6	2	20	19	95
	Pagurus bernhardus (L)	0.56	2	43	31	72.1
III	*Pilumnus hirtellus* (L)**	0.3	1	7	5	71.4
	Jaxea nocturna Nardo	0.26	2	10	2*	20
	Philocheras bispinosus bispinosus (Hailstone)**	0.24	1	9	0	0
	Palaemon elegans Rathke	0.16	2	7	7	100
	Hippolyte varians Leach	0.13	2	5	5	100
	Hyas spp.	0.1	1.1	4	2	50
	Macropodia rostrata (L)	0.08	1	3	2	66.6
	Upogebia deltaura (Leach)** 10/9/84	0.16	1	2	1	50
	Galathea squamifera Leach 14/6/84	0.08	1	1	1	100
	Xantho incisus Leach** 1/10/84	0.12	1	1	0	0
	Goneplax rhomboides (L) 1/8/84	0.07	1	1	1	100
	Pandalina brevirostris (Rathke)** 1/8/85	0.07	1	1	1	100

*Without pleopods-exact stage not identified.
**Absent from published records of the marine fauna of the Solway Firth (see text).
N.B. *Hyas* spp. = *H. araneus* (2) + *H. coarctatus* (2)

Table 2. Numbers of megalopae captured 1984-1986

	Species							
Months	*Hyas araneus*	*Macropodia*	*Polybiinae*	*Pilumnus*	*Pinnotheres*	*Pagurus*	*Pisidia*	*Porcellana*
May	2					1		
June						5		
July			2			2		
August				2			14	23
September		1	1		15		20	1
October							19	
Total	2	1	3	2	15	8	53	24

Although ZI stages form the bulk of the catches megalopae were also taken. None were taken for *Corystes*, which was surprising in view of the numbers captured and the four months of occurrence, and none for *Callianassa* and *Jaxea*. Equally surprising was the capture of megalopae of the spider crabs *Hyas araneus* and *Macropodia:* two of the former in mid to late May, 1985 and one of the latter in early September, 1984. On the other hand, five hundred and forty six *Carcinus* megalopae were taken (Fig. 3). Table 2 provides a summary of the other captures which may be of interest, particularly as the occurrence of megalopae marks the end of the planktonic phase.

ACKNOWLEDGEMENT

The author is grateful to Dr J. Mauchline for help with the literature on *Philocheras* spp.

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SHORT NOTES

Compiled by A.McG. Stirling

HISTORICAL

Peter Goodfellow

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The legacy of £100 by Peter Goodfellow funded a series of lectures from 1934 (Professor L.A.L. King: "A Short account of the Microscopical Society of Glasgow") until 1990 (Mrs Camilla Dickson: "Memoirs of a Midden-Mavis"). By then the fund was exhausted, but the Professor Blodwen Lloyd-Binns Bequest made it possible for Dr J.H. Dickson to reinstitute the series in 1995 by his memorable Goodfellow Lecture: "Otzi - The Iceman's last journey: clues from plants". Who was Goodfellow?

Peter Goodfellow was born in Glasgow in 1887 and died in 1933. He was an active field naturalist and enthusiast for the applications of the microscope to such studies. In 1886 he joined the Microscopical Society of Glasgow where he was a frequent exhibitor, twice secretary, and was elected Honorary Member in 1913 when he retired to Helensburgh. There he was a Founder Member and later Vice-President of the Natural History Society of Dumbartonshire. His publications include "The microscope as an optical instrument". The £100 bequest was left to "Glasgow and Andersonian Natural History and Microscopical Society" formed by amalgamation of the Andersonian Naturalists and the Microscopical Society of Glasgow – now Glasgow Natural History Society..

This short account of Peter Goodfellow is based on items in the Glasgow Naturalist of 1936, vol.12: p.56: King, L.A.L., the first Peter Goodfellow Lecture; p.124: Ewing, Mrs, In memoriam notice, Peter Goodfellow.

BOTANICAL

Scrophularia peregrina L. (Nettle-leaved Figwort) in two Milngavie gardens

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On my botanical travels abroad I often collect seed of those plants that take my fancy. Such a one was Nettle-leaved Figwort which I encountered in Italy, the precise locality having been between Ravello and Amalfi on the south side of the Sorrento peninsula and the date mid June 1991. In 1992 I grew the seeds which became big plants flourishing in large pots. Thereafter the species has become established in our small mixed vegetable patch. As I write this in July 1995 there are eight plants, seven among the potatoes and one with the beetroot. Our vegetable patch is already a distinguished one by the persistence of *Stachys arvensis* (Field Woundwort) which was present when we moved in in 1973. In 1992 a gardening friend who lives nearby grew my seed of Nettle-leaved Figwort in a border/rockery and because it spread too much he has weeded it but in July 1995 there are still three small plants, two small ones in the border and one larger one among onions.

Nettle-leaved Figwort has only very seldom been reported from Britain and not at all from Scotland according to Clement and Forster (1994) who list two localities in East Sussex without details and also Shapwick, Dorset, where it is a "persistent garden weed".

Nettle-leaved Figwort is the only foreign plant to spread and persist in this way in my garden although the seeds I bring home are mostly of perennial species and not of more or less weedy annuals as is Nettle-leaved Figwort.

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Clement, E.J. and Foster, M.C. (1994). *Alien plants of the British Isles.* Botanical Society of the British Isles, London.

Two Sedges new to the Glasgow Section of Lanarkshire

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We report the occurrence of two sedges seen for the first time in the Glasgow section of Lanarkshire (VC77).

Carex divulsa spp. *leersii* (a Grey Sedge) was first noted in 1988 (K.W.) on rough sloping grassland on the bank of the River Clyde near the Livingstone Bridge, Bothwell (NS/69.58). The identification has been confirmed. As seen by us in 1955 it is quite profuse, there being multiple scattered tussocks, some of which are adjacent to the tracks which traverse the area. This is a new VC record.

Jermy *et al.* (1982) state that the plant is strongly calcicole and Stace (1991) reports that it is a plant of hedgerows, wood borders and grassy rough ground, but only on chalk and limestone. We have tested the soil beneath two clumps growing at different parts of the site and the soil was found to be more-or-less neutral.

There are only three previous vice-county records for Scotland, all in the east or south-east: Braithwaite and Long (1990) report that the plant was found at Thirlestane Castle, Lauder, Berwickshire (VC 81) in 1975 and follow this without giving the reference with the statement "Gathered once when coming from Innerwick, by the side of the Water Eye" 1893; woods at Newbattle, Midlothian (VC83) (McKean 1988) and near Aberlady, East Lothian (VC 82) (Stewart 1985). This is therefore a significant new record. Specimens have been deposited in the herbaria of the University of Glasgow and of the senior author.

Carex muricata spp. *lamprocarpa* (a Prickly Sedge) was seen in 1995 on the waste ground of a long abandoned industrial complex in the Cessnock area of Glasgow (NS/56.64) by Mrs O.M. Stewart and the senior author. Despite an extensive search of the area only the one, strong, multi-stemmed plant was found and deposited in the senior author's herbarium.

This species has been seen before in Lanarkshire. Hopkirk (1813) stated that it was to be found occasionally in moist pasture near Airdrie. This is presumably the source of the comment by Lee (1933) that it was to be found, but not commonly, in wet pastures. It is interesting to note that Stace (1991) states that it is a plant of open grassy places, usually on dry, acid soils.

No VC77 records for this plant are given by Jermy *et al.* (1982). Despite recent searching it has not been located in the area around Airdrie. It is appreciated that it would be easy to mis-identify *C. muricata* spp. *lamprocarpa,* assuming that a plant seen was the superficially similar and more common *C. spicata* (Spiked Sedge). The latter is probably increasing locally. Nine tetrad records have been made within the Glasgow area within recent years and there have been six records in Lanarkshire, outwith Glasgow, since 1985. Of these records, a third have been verified by a referee. However, as far as we know *C. muricata* spp. *lamprocarpa* has not been seen in Lanarkshire for over 150 years.

Acknowledgement

We are grateful to A.O. Chater and A.C. Jermy for help with identification and A.McG. Stirling for helpful criticism.

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Pillwort at Loch Lomond

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The curious pteridophyte Pillwort *(Pilularia globulifera)* has for long been reported as occurring at Loch Lomond, Dunbartonshire, without supporting information as to precise locality or date of collection. There appears to be no relevant herbarium material in the collections we have examined, nor have we found any definitive reference in the literature.

The first mention of Pillwort at Loch Lomond appears to be by Hennedy (1865), and Watson (1873) lists it for '99 Dumbarton'. Lee (1933) also gives 'Loch Lomond' as a locality, no doubt merely repeating the earlier record of Hennedy. Ewing (1899) recorded *Pilularia* for '99 Dumbarton' apparently on his own authority; however, in view of his youth at the time of Hennedy's publication, he is unlikely to have been an early recorder of the Pillwort at Loch Lomond.

Over the years *Pilularia* has remained an elusive species at Loch Lomond in spite of considerable botanical investigations around its shore, particularly during the past thirty years. It is therefore with some satisfaction that it can be reported that the species was at last rediscovered by the writers in late September 1995 while examining the shore vegetation at the extreme northern end of Loch Lomond and the adjacent Geal Loch. *Pilularia* was noted in small quantity in two sites about 500 meters apart; the first on the east shore of Loch Lomond opposite an islet about 500 meters north-west of Ardleish (NN 323158) and the second by an outlet from the south end of Geal Loch (NN 318161). The habitat was similar at both sites - silty mud by runnels of slow-flowing water. The pillwort occurred either as low-growing, matted patches on exposed mud or submerged in clear water up to about 25cm in depth. In the latter situation the fronds were up to 20cm tall. This habitat type is very well described by Page (1988) under the heading 'Lake-head *Pilularia* sites'.

The prolonged dry weather conditions prevailing during the summer of 1995 and consequent low water level of Loch Lomond and its environs no doubt facilitated the detection of the Pillwort. It is listed as 'scarce' in the British Isles by Stewart *et al* (1994), and in continental Europe it is a Red Data Book plant.

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Limosella aquatica L. at Loch Lomond National Nature Reserve

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While examining plants of *Elatine hydropiper* along the NW margin of Wards Ponds in the Endrick Marshes area of Loch Lomond NNR, on 16 August 1995, we noticed a single specimen of Mudwort *Limosella aquatica.* Further searching a few days later revealed the presence of an additional six plants just a short distance away and by the end of the month a total of 18 rooted rosettes had been found. The plants were growing on a large expanse of exposed mud in an area much poached by cattle. The entire area was very sparsely vegetated but also present in the immediate vicinity were *Callitriche* sp., *Elatine hydropiper, Eleocharis acicularis, E. palustris, Glyceria fluitans, Gnaphalium uliginosum* and *Lythrum portula.* This suite of mainly annual species are all known associates of *L. aquatica* in its other ephemeral habitats, such as the drawdown zones of nutrient-rich reservoirs and regulated lakes (Salisbury 1970).

The seed bank longevity of this species in damp mud is unknown but *L. aquatica* populations are renowned for their erratic nature. While occasional plants may have been overlooked at Wards Ponds in the past we suspect this is a recent addition to the seed bank whose germination was induced by a combination of low water level, favourable temperatures and disturbance of the substrate by cattle. Introduction by wildfowl, which frequent Wards Ponds throughout the year, is the most probable mode of origin, since the nearest known station for this species is 32 km to the south at Balgray Reservoir, Barrhead, Renfrewshire (*Glasgow Naturalist* 19:341).

This record re-establishes *L. aquatica* in the flora of Dunbartonshire (VC 99), the last record being at the long defunct Hardgate Mill North Dam in the early years of this century *(Glasgow Naturalist* 1:168). More significantly it complements an emerging British stronghold for *L. aquantica* in central Scotland, first noted by Leach, Stewart & Ballantyne (1984), in contrast to the serious decline in the status of this species in England and Wales during the past century (Preston 1994)

(An earlier inclusion of *L. aquatica* in the Reserve plant list (*Glasgow Naturalist* 19:414) was an error. Compiler)

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Dual trees on Inchlonaig

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In a paper (Pilkington *et al*, 1994) on the Yews (*Taxus baccata* L.) of Inchlonaig, a 74.8 ha island in Loch Lomond, attention was drawn to the phenomenon of partnerships (usually involving large Yews with Birch (*Betula pubescens* spp. *tortuosa* (Ledeb.) Nyman), Holly (*Ilex aquifolium* L.), or Rowan *(Sorbus aucuparia* L.) where the roots of one tree were entirely enclosed by the wood of another. With unrelated trees the partnership will not involve true grafting but probably depends on the roots of the smaller partner growing in the hollow centre of the larger. With more closely related trees natural true grafting is a possibility. The words 'dual trees' were used to describe the tree partnerships and it was suggested that they had been poorly documented elsewhere. Dr. P. Binggeli has since drawn attention to a paper by Ludi (1941) which discusses dual trees in Switzerland and includes a detailed investigation into one involving False-acacia (*Robinia pseudoacacia* L.) with Sycamore (*Acer pseudoplatanus* L.).

In addition, Mr. J. Mitchell has sent a copy of a hand written report describing an excursion to Inchlonaig on 30th June 1900. This is a much fuller account than the later published report (Lee, 1908) and contains the following: 'An object of curiosity was noted in the shape of a Rowan and a Crab-apple tree, which had so grown together as to present the appearance of a single stem. The rowan seems to have a tendency towards amalgamations of this sort'. The Rowan and Crab Apple (*Malus sylvestris* (L.) Miller) partnership was not recorded on Inchlonaig during the recent study although there was a dual tree involving Rowan with Birch on the island. It is odd that the frequent partnerships involving Yew were not recorded on the 1900 excursion but the above dual record from that time confirms Inchlonaig as a site which is peculiarly favourable for the development of dual trees.

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ZOOLOGICAL

Lyme disease and tick removal

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Interest in ticks has been awakened by the publicity about Lyme disease. This infection typically causes a distinctive skin rash "erythema migrans" which may be accompanied by malaise, fever, headache, muscle pains and swelling of lymph nodes. If untreated, later problems may affect the joints, nervous system and heart.

The disease is caused by the spirochaete, *Borrelia burgdorferi,* which is transmitted by tick bites. Deer and many other mammals provide a natural reservoir of infection which does not normally make the animals ill. Ticks become infected by feeding on the blood of infected animals, and they too become life-long carriers of infection without suffering any apparent harm. However, the infectious bacteria may be in the fluid injected by the tick to stimulate and maintain the blood supply on which it feeds, and so may infect the host animal, thus perpetuating the cycle between tick and vertebrate hosts - which may include humans, normally a "dead end host" for the infection.

The risk of infection from a tick bite is negligible unless the tick has been allowed to remain attached for more than 24 hours, has been inexpertly squashed (contaminating the wound), has been clumsily squeezed during removal (thus squirting infectious fluid into the wound), or provoked to regurgitate by application of irritants such as alcohol, a lighted cigarette, or possibly asphyxiation by grease (as formerly suggested).

The essential is to notice the tick within 24 hours and remove it promptly. Without squeezing the body, grasp the tick as closely as possible to the skin, preferably by fine forceps, gently twist in either direction and pull out the loosened tick (see Figure 1). Scrape out any fragments left in the wound, and disinfect it.

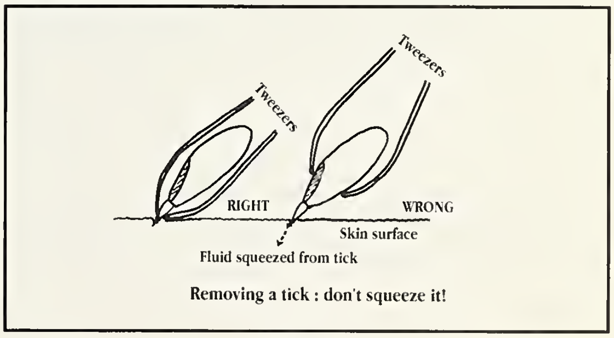

Fig.1

Further details are available in the review of infections transmitted by the world's many tick species (Grist, 1992) and more recent papers on Lyme disease (Matuschka & Spielman, 1993; Maggs & Veale, 1994; O'Connell, 1995; Grist, 1995).

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A further locality for the Purple Hairstreak Butterfly

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22 Muirpark Way, Drymen G63 0DX

The search for Purple Hairstreak *Quercusia quercus* (L.) colonies linking the butterfly's main stronghold on Loch Lomondside with the apparently isolated population at Garscadden Wood, North Glasgow (Mitchell, 1993) was resumed during the hot and sunny summer of 1995.

On 2nd August, small numbers of Purple Hairstreaks were seen along the upper edge of Auchentorlie Wood (NS 432747) between Milton and Bowling, Dunbartonshire. The Site is particularly favourable for observing this elusive treetop butterfly, for it is possible to make close contact with the crowns of some of the wood's perimeter oaks from the steep slopes of Craigunnock above.

Reference

Mitchell, J. (1993). Additional localities for the Purple Hairstreak butterfly. *Glasgow Naturalist* 22, 285.

The Death's-head hawk-moth in Ayrshire

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In mid-October 1994 a large moth had attracted the attention of children playing in the street in Sorn (National Grid Reference NS 554265). It was tentatively identified as a death's-head hawk-moth (*Sphinx atropos* L.) by the first author on the basis of its general appearance, this being confirmed by the comment that it appeared to emit noises when alive. A photograph of the damaged specimen was taken, in which the pronotal pattern is just visible, and on this basis the specimen can be identified with absolute confidence. Unfortunately the only detectable fragments remaining in street debris in January 1995 were some parts of the fore-wings and abdomen.

According to the map provided by Gilchrist (1979), there are few records of this species from the west of Scotland, but it has been previously noted in Ayrshire.

Reference

Gilchrist, W.L.R.E. (1979). Sphingidae. In Heath, J. and Maitland Emmet, A. (eds). *The Moths and Butterfield of Great Britain and Ireland*, Volume 9. Curwen Books, London.

A further record of Sea Lamprey, *Petromyzon marinus* L. in the River Clyde

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On 18th July 1995 a female sea lamprey was found dead in the River Clyde by Clyde River Purification Board staff just above the tidal weir in Glasgow (NS 597642). The badly decomposed specimen was about 60 cm long and had not yet spawned: eggs were readily expelled from the vent on handling. The lamprey was discovered during investigation of a fish mortality affecting mainly adult salmon, but also including a few flounders, in the Clyde between Dalmarnock and Glasgow Green. Salmon had been dying over a period of several days following a prolonged spell of warm, dry weather culminating in heavy thundery showers. The fish deaths were caused by low dissolved oxygen concentrations, probably resulting from a combination of low river flows, high water temperatures and the effects of storm sewage flushed into the river during heavy downpours. This is the second known recent record of sea lampreys in the Clyde. The first was a male found dead at Cambuslang in June 1993 (Doughty, 1994).

Reference

Doughty, C.R. (1994). Sea Lamprey, *Petromyzon marinus* L. in the River Clyde. *Glasgow Naturalist* 22, 432.

Humpback Whale (*Megaptera noveangliae*) in the Clyde estuary

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From late December 1994 until mid March 1995, a Humpback Whale (*Megaptera noveangliae*) patrolled an area of the upper Clyde around the Tail O' the Bank, between Greenock and Helensburgh. This represented the first known record of the species in Clyde waters and one of the few modern records of the species in Scotland.

The overall length was estimated at around 10 metres. On several occasions the whale came within 20 metres of the

Humpback Whale breaching on the Clyde, with Helensburgh in the background.

public esplanade at Greenock and fine views of the "bubble-net" feeding behaviour could be obtained. Shoals of small fish, probably young herring, could be seen showering from the enormous mouth as the Humpback surfaced. Around one tonne of small fish daily has been estimated as the feeding requirement for this species. Unusually large numbers of auks, grebes and divers were also present in the Clyde estuary during the same period, suggesting an abundant food supply. On a few occasions the whale was sighted just off Dumbarton Rock, where the Clyde is very shallow at low tide. Other sightings were from around Wemyss Bay. Occasionally the whale would breach and create a huge splash which could be seen from either side of the Clyde. The accompanying photograph (by Stuart Bearhop) shows a breach and displays the long white pectoral fins which are diagnostic of this species.

I thank Iain Gibson, Zoe Russell, David Carnduff (Greenock Telegraph) and Stuart Bearhop for their notes on whale sightings.

A specimen of the Fan Mussel *Pinna fragilis* (Pennant) from the Firth of Clyde

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In his review of Scottish records of the Fan Mussel *Pinna fragilis*, Woodward (1985) listed three from the Firth of Clyde. One of these was an unconfirmed record from Lamlash, Arran but the other two, from Kintyre and Bute were supported by specimens.

The skipper of the Girvan fishing vessel "Osprey", Mr Simon Jack informed me, in July 1995, that he had from time to time trawled up specimens in Clyde waters, although they were by no means common. He was able to produce from the hold of his trawler a fine specimen of the Fan Mussel which had been trawled in an area of deep water near the Mermain Shoal, about 10 kilometres from Corsewall Point, and south of Ailsa Craig, in summer 1990. Mr Jack kindly gave me the two valves and I have since donated these to Kelvingrove Museum. When drying out, the shells become very brittle and crack, hence the specific name.The distribution of the species is well covered in the notes by Woodward (1985, 1987) and this further Clyde specimen shows that the species continues to exist in Clyde Waters.

Rreferences

Woodward, F.R. (1985). The Fan Mussel, *Pinna fragilis* (Pennant) in Scotland. *Glasgow Naturalist* 21, 63.

Woodward, F.R. (1987). Molluscan Notes - *Pinna fragilis*. *Glasgow Naturalist* 21, 358.

Overwintering common frog tadpoles

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It is well known that throughout Britain, common frogs (*Rana temporaria*) and toads (*Bufo bufo*) spawn in early spring, producing large numbers of tadpoles, some of which survive to metamorphose over the summer. Smith (1951) recorded the minimum time for frog tadpoles to reach metamorphosis as 10 weeks; toads - 65 days. However, it may take much longer, depending on factors such as temperature, tadpole density and food availability.

It is less well known that tadpoles are capable of overwintering in the water, to metamorphose the following year. Smith (1951) described a pond in Yorkshire where toad tadpoles regularly overwintered, metamorphosing at around the normal time, but the following summer and at a larger than normal size. He also noted that overwintering is not uncommon for frog tadpoles in mountain districts, where spawning occurs late and water temperature is low, and quotes observations by Gadow (1901) who found tadpoles in a mountain tarn in North Wales, with forelimbs emerged by late September, hibernating under stones.

How commonly overwintering occurs in Britain seems not to have been investigated, and Frazer's (1983) update of Smith's book does not mention it at all. Overwintering is better known in North American bullfrog and green frog tadpoles (Werner, 1994).

The observations recorded here are from a garden pond at low elevation in Aberdeenshire. The 1.1m^2 rain-fed pond was established in 1980, but the first known frog spawning was in April 1994. Metamorphosed froglets were first noticed around the pond in August. However, many tadpoles remained in the pond and were regularly observed, still active, right through the winter. On one occasion in December, after a severe frost, three tadpoles were found embedded in 2cm thick ice. Remarkably, after slow thawing indoors, these tadpoles immediately became active again.

New spawnings occurred in late March 1995, with about 20 of the overwintered tadpoles now actively swimming about in the water and around the spawn. The new spawn hatched in late April. By this time the large overwintered tadpoles were noticeably pear-shaped. Obvious rear-legs became visible in some by the end of April. The exact time of completion of metamorphosis was not determined, but forelimb emergence and tail shortening was noticed by early June. Some of the 1995 batch of tadpoles began to metamorphose in September.

Many studies have now shown (review: Duellman & Trueb, 1983) that vertebrates with complex life cycles (amphibians; fish such as salmon) make decisions on when to change from one form to the other on the basis of factors such as the resources available in their current environment. However, little is known of this in British amphibians and the observations recorded here suggest that further work could be fruitful. In addition, the ability to survive freezing is well-known among some North American adult frogs (Costanzo, 1992), but we know of no similar observations to ours on tadpoles in Britain.

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Frazer, D. (1983). *Reptiles and Amphibians in Britain*. Collins, London.

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Update on Kingfishers on the River Kelvin

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Kingfishers have remained active on the River Kelvin since my last report (Skillen, 1993). Two were seen flying together at Belmont Street Bridge, Hillhead, on 27th November that year. Adult birds with young were seen in 1994, the old weir below the Art Galleries being one site. Perch sites were established and locations included willows close to the river near the overbridge carrying Kelvin Way. Balsam about an old sewer outlet at Otago Street was also used. Perhaps the principal site was the flint mill near Botanic Gardens where on 27th November four birds were encountered flying together. In December 1994 severe floods wrecked the riverbank perch sites and it is unclear what then happened to the birds as a gap of ten weeks ensued before I saw any kingfishers again. In February 1995 kingfishers were again on the river with a bird established in the lade leading to mills formerly on the Bunhouse Road. In April it became clear that nesting had begun and on the 12th a bird was seen taking fish down a bank side hole in Kelvingrove. Fishing trips of 6-12 minutes duration were regularly made down river, the bird flying back up stream with fish and emitting a high whistling note. On 27th April a bird came very close to me as I stood on the footbridge over the Kelvin. Unusually, the kingfisher flew over the bridge and was having difficulty in keeping to its normal flight pattern; it clipped a tree as it swerved away from me, but kept flying. In May kingfishers were feeding young, fishing trips being made down river of Partick Bridge and to the mouth of the Kelvin, with observable fish depletion in the park area. On 5th June a tussock exposed in very low water below West Bank Terrace, off Gibson Street, was being used by an adult with a young bird. A brief rise in water levels after rain saw activity about the old weir below the Art Galleries on 10th July. Two birds were seen on the foundation work of the weir, one of which was calling sharply. Probably the same two birds used willows from which to fish on 12th July attracted by fish jumping in the low water of the park section of the Kelvin.

Increasingly low water limited opportunity for kingfishers in Kelvingrove as fish stocks fell. Regular river bed visits on this section were possible due to the very low water and no fish were seen on these surveys. Possibly fish stocks were also affected as sand and gravel got into the Kelvin from bank side repairs about the flint mill. Floods, the wrecking of the weirs and the drought may all have affected the kingfishers. The extension of fishing trips along the river hint at less opportunity about Kelvingrove. The expansion of activity down river of Partick Bridge shows a notable change on observed fishing and flying patterns from 1993. The kingfishers sought fish further and further afield and I had no sightings in Kelvingrove until 31st October after heavy rain had brought a dramatic rise in water levels and on that date and again on 2nd November, a kingfisher was active close to the pedestrian bridge in Kelvingrove. A bird was also seen on 17th November below West Bank Terrace. Kingfisher activity is maintained on the River Kelvin but the hot summer and reduced water flow, aggravated by the weir destruction, cast doubt on their future about Kelvingrove.

Reference

Skillen, B.S. (1993). Kingfishers on the River Kelvin. *Glasgow Naturalist* 22, 289-290.

Parasites on parasite

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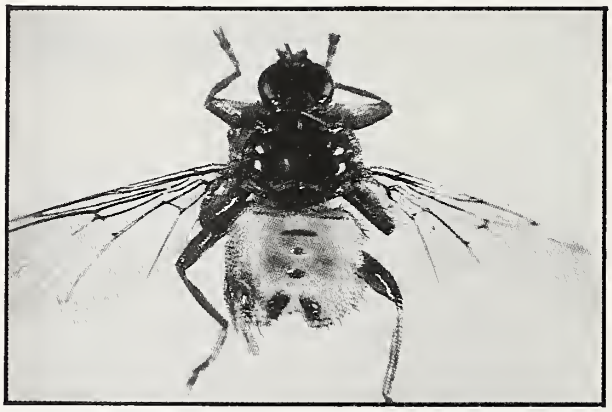
A juvenile blackbird from Cardross, Dunbartonshire was sent to Glasgow Museums by Mrs Flora Leckie. It was suitably fresh when it came to the museum, in August 1992, for an ectoparasitic fly still to be found associated with it. These kinds of insect belong to the family Hippoboscidae and are generally known as flat flies. This is because they are flattened from top to bottom, an adaptation which allows them to move easily between the feathers or fur of their host. Of the three likely species of such fly this one turned out to be the most unusual, *Ornithomyia avicularia* (L.) for which there are very few Scottish records. The latest work which deals with the family (Hutson, 1984) gives the distribution of *O. avicularia* as scarce in northern England and southern Scotland.

Of additional interest is the presence of two feather lice clinging to the flatfly. Their specific identify is currently under the scrutiny of Neil Redgate as they could be one of at least four species in the genus *Brueelia* (Mallophaga; Philopteridae). The accompanying photograph shows them in position as found. The feather lice also normally live amongst the plumage but when their host dies they are in great danger of dying. They have no means of locating another host of the right species if the bird dies away from a nesting site. This tendency to attach themselves to any other moving object has a potential survival value. The flatfly could be regarded as a life raft as it is capable of flying away and finding another host. This piece of behaviour is referred to by Rothschild & Clay (1952) but I have not seen a photographic record of it.



Flat-fly *Ornithomyia avicularia* with attached feather lice.

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BOOK REVIEWS

Compiled by RUTH DOBSON

The New Naturalists

PETER MARREN

Harper Collins, London, 1995, 304 pp., softback with 16 colour plates, black & white photographs.
ISBN 0 00 219997 1, £14.99
(hardback, ISBN 0 00 219998 X).

There can be few people, even including those whose interests are only marginal to the study of natural history, who would not recognise one of the New Naturalist volumes. They would recognise it not only in a physical sense but appreciate that each one has been carefully written not only by an expert but by an enthusiast for the study of the subject. This book marks fifty years of publishing the series and gives much detail on both the development of the idea and the practical issues which faced the editorial board from the beginning. It describes their personalities and those of the authors they commissioned.

Peter Marren has brought his light style and wit into making an easy read. Even the parts which could have been dry bibliographic detail are made interesting. Now you can find out why it is almost impossible to get hold of a first edition of No. 9 or why dust jackets can be nice and clean while the innards are definitely dog-eared.

There is something for everyone here. The art work of the covers is given a thorough treatment through both an assessment of the artists' pedigrees and a discussion of what part the graphic design played in the success of the series. For once it is possible to agree whole-heartedly with the publishers' blurb when it refers to this being an account of the 'trials, tribulations and triumphs of the most significant and long-running natural history series in the world'. Everyone who treasures just one of the previous volumes will want to read, and most probably possess, this one as well.

E.G. Hancock

The End of Evolution: Dinosaurs, Mass Extinction and Biodiversity

PETER WARD

Weidenfeld and Nicolson, London, 1995, 302 pp., hardback with black and white photographs. ISBN 0 297 81475 3, £18.99.

I have recently read three excellent books by American scientists that close with an account of the biodiversity crisis: Jared Diamond's 'Rise and Fall of the Third Chimpanzee' which attempts to explain the unique features of the human species; Edward Wilson's 'Diversity of Life' which describes the processes of evolution and ecology; and now Peter Ward's account of the three main periods of mass extinction - the ends of the Paleozoic and Mesozoic eras, where a good case can be made for asteroid impact as a prime cause, and our current predicament with human beings taking the role of asteroid.

Each of these books is in what I regard as the best tradition of semi-popular science-writing, where the facts and interpretations are interwoven with an account of the scientists involved, and their context, so that the whole story comes to life: I highly recommend all three.

Ward is a paleontologist from a geological background. As he notes, a curse of our modern specialised world is that most paleontologists learn their trade divorced from botany or zoology, and have to learn about living plants and animals “on the hoof”. His personal interest is in ammonites, a vast assemblage of marine cephalopods that failed to survive the Cretaceous-Tertiary boundary extinction. From this work has arisen his interest in the causes of extinctions in general.

Part one, an analysis of the First Event (the end of the paleozoic) begins with a brief history of the science of Geology and how Geologists have pieced together the Earth's timescale. Ward takes us to the Karroo, a high plateau in South Africa and the best site for fossils of the assemblage of proto-mammals that mostly died out at the end of the Permian period. Two Scots were prominent in the recording of these fossils, one a hero, Andrew Geddes Bain, was the first to recognise their importance; the other, Robert Broom, something of a villain, abused his position as a museum curator by selling (to the USA) a fossil collection that was not his to sell and confused posterity by his tendency to erect species on the minutest differences between fossils. The traditional view has been that this extinction was gradual: Ward contends that the true picture is of slow decline but with a short terminal catastrophic period of no well-established cause.

A relatively depopulated Earth provided the opportunity for enormous adaptive radiation that culminated in the Age of the Dinosaurs. Ward is sympathetic (too sympathetic?) to the revisionist view that sees the Dinosaurs as highly active, warm-blooded animals, well capable of keeping the co-existent mammals to a minor set of nocturnal niches.

Much of Part two, the Second Event, is a vivid account of the Alvarez hypothesis that an asteroid produced the global catastrophe that wiped out the Dinosaurs, and many other groups besides. This part is particularly strong on scientists as people, with all their ambitions and jealousies, rather than as calm discoverers of the truth. Ward again concludes that the evidence both for slow, climate-induced decline and for a catastrophic impact is too strong for either to be excluded.

Part three, the Third Event, opens in the Republic of Georgia where Ward has gone to examine the fossil evidence of the end of the Dinosaurs and the beginnings of the Cenozoic era in the Caucasus mountains, symbolically just at the time of the end of another empire (the Russian) and the confused searching for something new.

This part concentrates on mammalian diversification and the origins of the human species, then on to the period of the last two million years of cooler climates, induced by the drift of a large land mass, Antarctica, to the South Pole. The closing chapters present the evidence that we are well into the Third Event, another period of major extinction, possibly the most severe of all because based on a larger number of species than before. The causes are again a slow, climate-induced decline, capped by a catastrophe - this time, the impact of the human species. Readers of Diamond and Wilson will now be on familiar ground - the destruction of North American mammals and Pacific islands flightless birds. Ward adds the pathetic farce of the indigenous fauna and flora of Hawaii, particularly the land snails, collected to near extinction and dealt the final blow by bumbling attempts to control agricultural pests. Finally, a chapter of hope: people now recognise the plight of other species and may now be in a mood to persuade politicians to act to conserve what is left of biodiversity.

Some minor reservations: Ward's picture of the Dinosaurs one-sidedly accepts Bakker's position; this is untypical of a book which scrupulously presents both sides of most controversies. Next, there is little attempt to account for the survival of some species at the end of the Cretaceous, given the severity of the envisaged catastrophe. On production, Ward keeps the flow by relegating references to a set of notes at the end - these will be fine for the general reader but are sparse for anyone wishing to read further.

Finally, though this may not be the author's fault, I didn't feel that the book justified its title: Ward makes no attempt to argue that our current spasm of extinctions means the end of evolution: indeed, the message of the book could imply that mass extinctions, while painful, open new opportunities for evolution - eventually.

Let's hope this marvellous book is a paperback soon, and very widely read.

Roger Downie

Fossils (Collins Gem Guide)

DAVID M. MARTELL (Illustrated by MARK HAY)

Harper Collins, London, 1995, 255 pp., softback with over 200 coloured illustrations. ISBN 0 00 470493 2, £3.50.

This is a most useful pocket-sized guide for beginners and the more knowledgeable alike.

It is packed with information detailing how the book should be used; how fossils can be related to the mythology of ancient civilisations; what fossils are; their uses and formation; evolution and extinction.

Geological maps are provided for Great Britain and Europe and a generalisation of the best locations for finding palaeontological specimens in Britain is supplied. Geological time is explained and a map given. A section on the equipment required for fossil collection is included while a most necessary page on safety precautions should be read and memorised by the beginner.

Over three hundred fossil species are dealt with, these being divided into fossil invertebrates, fossil vertebrates, fossil plants and trace fossils with each section being colour coded. The text on the individual species is informative and terms unfamiliar to the beginner are explained in the glossary. The book is instructively illustrated throughout.

Joyce Alexander

Laboratory Manual for Physical Geology (9th Edition)

JAMES H. ZUMBERGE, ROBERT H. RUTFORD AND JAMES L. CARTER

Wm. C. Brown, Dubuque, USA, 1995, 228 pp., hardback with colour and black and white photographs, maps and diagrams. ISBN 0 697 13829 1, £18.95.

As the title suggests, this book is aimed at students learning about basic physical geology and it is designed to complement formal teaching of the subject. It comprises five parts dealing with earth materials, topographic maps, aerial photographs, remote sensing and their interpretation, structural geology and plate tectonics. Each part has a general introduction, followed by a series of practical exercises. Several exercises start with the words 'Your instructor will provide ...'. It will prove quite difficult to do these unless the reader has access to suitable specimens and special equipment such as a stereoscopic viewer to look at the spectacular 3-D stereoscopic aerial photographs. However, several others, such as "locating the epicentre of an earthquake" need only a pair of compasses and the manual to be able to do them.

Being an American publication, the examples are inevitably from North America. This is not a problem and I found it fascinating to read about such things as the impact of the Mount St. Helens eruption of 1980 on the surrounding topography.

As a laboratory manual, I found this a very good publication for learning basic geology. The background information is very readable but it is a bit frustrating not being able to do all the exercises if you don't have the right samples etc. If you have access to a stereoscopic viewer, however, it could be an endless source of interest!

I would recommend anyone starting to learn about geology to consult it.

Richard Sutcliffe

Historical Ecology of the British Flora

MARTIN INGROUILLE

Chapman & Hall, London, 1995, 347 pp., hardback with illustrations. ISBN 0 412 56150 6, £22.50.

This is an account of the development of the British flora from earliest times to the present though with most emphasis on the last 14,000 years or so, the classical late-glacial and post-glacial periods. I found it easy to read and with very good coverage of the topics and I have already put it on the reading list for students taking my option on Quaternary palaeoecology.

However, I shall be cautioning the students about various matters. Figure 1.1 shows pollen grains; these could only have been drawn by someone who does not really know the crucial features one needs to see. The interest of the recurring representation of halophytes in the floras of the last glacial period is not given proper treatment; were they growing on salty soil or not? On page 118 the fallow deer is claimed as a British native; surely this is not so. Despite the statement on page 126, *Saxifraga cernua* does not grow on Snowdon, indeed not in Wales or England. I have never seen remains of Scots Pine on Ben Lawers as claimed on page 127 and the account of this history, of that tree does not bring out its fascinating complex history, especially in Scotland. Similarly the account of the famous elm decline of 5,000 years ago is not adequate. Misled by an incorrect recent publication, the author has credited the Romans with clearing the Scottish woodlands. This is quite untrue; they marched into a southern and central Scotland already greatly cleared of woodland.

Finally I was glad to see that his account of aliens begins "Undesirable Aliens?"; the question mark is important. There is in my opinion a strong case to be made that such plants as Giant Hogweed and Japanese Knotweed should be seen as interesting additions to the British flora. Urban floras would be a good deal less colourful without the many alien species that flourish in waste ground and other habitats.

J.H. Dickson

Alien Plants of the British Isles

E.J. CLEMENT & M.C. FOSTER

Botanical Society of the British Isles, London, 1994, 590 pp., softback. ISBN 0 901158 23 2, £15.

This book attempts to cover all alien plant species (except grasses) however short-lived or infrequent that have ever been reliably recorded in the British Isles.

The 363 page catalogue section is packed full of information. It gives accounts of plants in the following sequence: scientific name; name in English; frequency; means of introduction; status; origin; location of voucher specimens; reference and synonyms.

The aim has been to produce not just a checklist, but also an aid to identification. Where the genus is known, clues to the most likely species are given by the number of bullet symbols used and by the means of introduction. Further, references to illustrations and descriptions are given as appropriate, as well as the location of voucher specimens.

In the course of a letter to me in 1975, one of the authors (E.J.C.) stated that he knew little about Scottish aliens and would be grateful to receive relevant information. Accordingly, for the past 20 years I have sent him a photocopy of every article from the Glasgow Naturalist in which there was mention of an alien.

Inevitably in a number of cases in which aliens are stated to be in a particular location, they are no longer present. A case in point related to *Aster schreberi* under which heading is the statement "established since 1931 at Lochside station (Renfrews)". It is almost ten years since redevelopment and landscaping at the station exterminated the plant. Perhaps one should be just as punctilious in reporting losses as in reporting gains!

The authors are to be congratulated on their dedication in amassing all the available information. The book is now, and will remain, the standard work on the alien flora for an appreciable time. It is very reasonably priced and strongly recommended.

P. Macpherson

Plants and their Names: a Concise Dictionary

ROGER HYAM & RICHARD PANKHURST

Oxford University Press, Oxford, 1995, 545 pp., hardback. ISBN 0 19 866189 4, £14.99.

This is a reference source for 16,000 of the more commonly occurring scientific and vernacular names for herbs, shrubs, trees and ferns worldwide. It contains over 500 family entries, over 2,000 genus entries, over 5,000 species entries, over 2,000 of the more commonly occurring specific epithets and over 6,000 common names.

Plants are described along with details of their geographical distributions, applications to medicine and industry, the derivations of their names and any unusual facts and beliefs concerning them. A full glossary of technical terms and abbreviations is added.

This is a fascinating book, a mine of knowledge, easy to use when seeking specific information and interesting reading for browsing at leisure.

Ruth H. Dobson

Orchids of Britain & Europe (Collins Photo Guide)

PIERRE DELFORGE

Harper Collins, London, 1995 (Originally published 1994 in French by Delachaux et Niestle SA, Lausanne, Switzerland), 480 pp., hardback with numerous colour photographs and several line drawings. ISBN 0 00 220024 4, £16.99

Orchids which grow wild in the temperate regions form a highly interesting family group owing to their large diversity of colour and form and their frequent readiness to hybridise. We have seen over the last two decades a succession of identification books of increasingly higher standard, from Turner Ettlinger of 1976 to Lang in 1980 and in the Scottish context by Allan, Woods and Clarke in 1993. An important feature of all these is the use of colour photographs. By contrast, earlier popular guides to British flora from Collins - McClintock and Fitter (1956) and Fitter, Fitter and Blamey (1974) have used coloured hand drawings which although generally effective, give a poor representation of Orchid flowers for reliable identification.

Collins have already published *A Field Guide to the Orchids of Britain and Europe* (1978, 176 pages) with superior hand drawn colour illustrations. We may take the present work to be its successor, in which the number of species described has considerably increased from 138 to 375. Modern colour photography has been used here to its best advantage, although as is often the case, the printing rendition of pink and purple flowers is occasionally inaccurate. The Northern Marsh Orchids for instance show a magenta-red shade rather than a rich purple. However the details of form and patterning of all the flowers are of a high standard and will amply assist recognition. The pictures are accompanied by a wealth of detail concerning descriptions, habitat and distribution.

The book is a veritable treasury of information about the Orchids to be found throughout Europe and neighbouring lands. Pierre Delforge assiduously explains the principles of classification and nomenclature, the characteristics and anatomy of Orchids and their systematic position in the plant kingdom. These themes have been addressed by earlier works, e.g. Summerhayes (1951), but Delforge brings a refreshing approach. It is noted that there are a number of changes introduced in the Latin nomenclature for some Orchid species. For example, the Heath Spotted Orchid occurring in Britain is now *Dactylorhiza ericetorum,* separated from *D. maculata,* when for some years we have been accustomed to call it *D. maculata* spp *ericetorum* (compare Stace 1991).

The author gives sound advice about the best way of studying Orchids with some useful details on photography. Specialist terminology abounds but this should not deter even the casual amateur. A comprehensive glossary is provided for those requiring a lucid explanation of the terms used. The quality and price make this excellent volume a worthwhile purchase for all who wish to know this fascinating group of plants more intimately.

References

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Stace, C.A. (1991). *New Flora of the British Isles.* Cambridge University Press, Cambridge.

Summerhayes, V.S. (1951). *Wild Orchids of Britain.* Collins New Naturalist Series, Collins, London.

Turner Ettlinger, D.M. (1976). *British and Irish Orchids.* Macmillan Press, London.

Williams, J.G., Williams, A.E. and Arlott, N. (1978). *A Field Guide to the Orchids of Britain and Europe.* Collins, London.

Bill Parkes

Alpine Flowers of Britain and Europe (Collins Pocket Guide, New Edition)

CHRISTOPHER GREY-WILSON AND MARJORIE BLAMEY

Harper Collins, London, 1995, 357 pp., hardback with many coloured illustrations. ISBN 0 00 220017 1, £12.99.

This essential field guide has been completely rewritten for its new edition. Every species found in the mountainous regions of Britain and Europe, including for the first time the mountains of Eastern Europe, has been described in detail, with major characteristics highlighted. Scientific names have been brought up to date, and synonyms expanded. The key using the appearance of the flower has been omitted, but the family names have been kept in English, and are conspicuous at the top of the page. The code for distribution by country has been changed and internationally accepted codes adopted, making it easy to see at a glance if a plant occurs in any specific country.

At first glance the attractive colour plates seem identical with those of the first edition, but closer inspection reveals that the rather boring black and white drawings of white or greenish flowers plus some yellow composites, found at the back of the first edition, have been replaced by colour paintings, and placed in their correct position among the families.

Slightly thicker and 125 gms heavier, the new edition is almost double the price of the one I bought in 1990. But at £12.99 it is still excellent value and I would recommend this field guide to anyone exploring the mountains of central Europe. Bear in mind that it does not cover grasses, sedges and rushes, or non flowering plants such as ferns, horsetails and clubmosses.

Edna Stewart

Scottish Wild Flowers (Collins Guide)

MICHAEL SCOTT

Harper Collins, London, 1995, 256 pp., softback with numerous colour illustrations. ISBN 0 00 219982 3, £7.99.

As with "Scottish Birds", published last year in this series and reviewed by Bernard Zonfrillo for GN, this is a book for beginners. As with the birds the species are described by habitat, and only a few plants for each habitat are included. This could cause frustration unless used with another flora, which is recommended by the author. The plants and places are described with such enthusiasm and authority that beginners must be eager to visit the sites and find the flowers. There are several excellent photographs taken by the author and the illustrations of the individual species have been taken from Collins "New Generation Guide to the Wild Flowers of Britain and Northern Europe". The plants within each habitat are arranged and named following Stace and the Common names follow Dony, Rob and Perring except where a Scottish name is in wide usage. It is good to see the Gaelic names by Joan Clark and Ian MacDonald, and interesting for non Gaelic speakers to have the literal meanings of these.

Highly recommended as a first Flower Book for Scottish residents or for visitors to Scotland.

References

Dony, Jury and Perring (1986). *English names of wild flowers.* Botanical Society of the British Isles, London.

Stace, C. (1991). *New flora of the British Isles.* Cambridge University Press, Cambridge.

Jean M. Millar

Trees (Collins Gem Photoguide)

DICK WARNER (Photographic consultants, DAVID & JEAN HOSKING)

Harper Collins, London, 1995, 256 pp., softback with over 200 coloured photographs. ISBN 0 00 470545 9, £3.50.

This is a delightful little book. It is packed with useful and fascinating information. The author, Dick Warner, is enthusiastic about his subject and imbues the interested reader with this enthusiasm.

The introduction covers aspects such as the natural history of trees; types of trees and how they grow; their evolution, conservation, preservation and management; tree age; growing trees; plus helpful hints on tree watching (binoculars are not just for bird watching!). Throughout the book botanical jargon is kept to a minimum.

Over two hundred of the commonest tree species in Northern Europe have been described and arranged in families. Each species has a short descriptive and informative text followed by four quick reference sections and accompanied by a small illustration of the tree's outline.

The photographs show the most important details of the tree, be that leaf, blossom or fruit, and there is a cross-referenced section at the back of the book showing additional features.

Joyce Alexander

Mushrooms and Toadstools of Britain and Europe (Collins Field Guide)

R. COURTECUISSE AND B. DUHEM

Harper Collins, London, 1995, 480 pp., hardback with many colour illustrations, line drawings, map. ISBN 0 00 220025 2, £14.99.

This is not a rehash of the 1963 Collins Field Guide to Mushrooms and Toadstools, by M. Lange and F.B. Hora, but is an entirely new, much larger and more comprehensive work which has been beautifully produced and is clearly a most welcome contribution to its subject.

Intended as an introduction to Mycology, as well as a diagnostic guide, the text opens with sections on the characteristics and possible origins of fungi, their morphology, systematics, ecology, conservation and significance. Hints on how to prepare herbarium specimens are provided and the symptoms and consequences of fungal poisoning are detailed. This is followed by a comprehensive (71 page) key to species which uses habitat characteristics as well as morphological ones. The main section consists of concise descriptions, with details of habitat and occurrence in Europe of 1751 species of macrofungi, supported by excellent colour illustrations. Diagnostic characteristics of almost as many similar additional species are given at appropriate points.

Criticisms are few. The text has been translated from the French and this shows in the form of numerous circumlocutions which could have been eliminated; a larger font would have enabled more comfortable reading and the acknowledgement section lacks the list of acknowledgees.

Ronald.M. Dobson

Field Guide to Insects of Britain and Northern Europe

BOB GIBBONS

Crowood Press, Marlborough, 1995, 320 pp., hardback with over 700 colour photographs, many line drawings.
ISBN 1 85223 895 X, £14.99.

The title of this book so closely resembles that of a well-known Collins publication that comparison seems inevitable. Both books have much in common but the approach and emphasis differs. The Collins text adopts a systematic approach and identification (as far as practicable) is through keys supported by pictures. The present publication, however, relies principally on colour photographs with accompanying text. There is a brief key to orders but systematics are minimal.

These books kindle interest in insects and give guidance in study and appreciation but they are not diagnostic manuals. Although many conspicuous species can be recognised from the illustrations and descriptions in the present publication, many can not and claims given on the cover are optimistic.

Accounts of insect structure, physiology, life history, ecology, migration and other features, and hints on field work and photography, are followed by brief descriptions and ecological data on 1000 or so species. There is a useful section on insect- and mite-induced plant galls. A bibliography, address list and index conclude the book.

The quality of production is good and while most plates are excellent some are poor. Family names appear sporadically and it is not always clear where such groupings end: for example, *Chrysis* and *Mutilla* both appear under Formicidae. Protura, Siphunculata and Mallophaga have been omitted; the larva drawn on p.14 has too many prolegs; chalcids (p.23) and *Siphlonurus* (p.42) are both misspelt. More rigorous editing seems to be required.

Ronald M. Dobson

Spiders of Britain and Northern Europe (Collins Field Guide)

MICHAEL J. ROBERTS

Harper Collins, London, 1995, 383 pp., hardback with many colour and black and white illustrations.
ISBN 0 00 219981 5, £14.99.

British spiders were for long a neglected group and it was only in the 1950s, when the Ray Society Monographs by G.H. Locket and A.F. Millidge became available that their identification by amateur naturalists could easily be attempted. These publications reigned supreme until the mid 1980s when a new standard of identification literature was established with the appearance of the 3-volume Harley Books account by the author of the present publication. Here detailed descriptions of each species were supported by fine line drawings of specific characteristics and 237 exquisite colour plates, all executed by the author.

This latest Collins Guide is simply excellent. It deals with North European species as well as British ones, the drawings and colour plates are all new, and the individual species accounts are preceded by a substantial introduction to the biology and study of spiders. A preliminary key enables specimens to be allocated to their correct families and further identification is by reference to the illustrations of palps and epigynes and to the colour plates.

A book of this size, partly intended for field use, cannot be wholly comprehensive, so with the exception of a few conspicuous species, the very numerous tiny "money spiders", the Linyphiidae, have been omitted. For these the earlier literature will still be needed.

As the first, readily accessible, first-class account of spiders this book is highly recommended.

Ronald M. Dobson

Butterflies and Moths (Collins Gem Photoguide)

MICHAEL CHINERY (Photographic consultants, DAVID & JEAN HOSKING)

Harper Collins, London, 1995, 256 pp., softback with over 200 coloured photographs. ISBN 0 00 470757 5, £3.50.

This pocket guide deals solely with the imago stage of the two hundred and forty Lepidoptera commonly found in Britain and Europe. There is an instructive introduction explaining the life history and feeding habits of butterflies and moths and the basic differences between them.

Twenty two families are dealt with and a colour coded key is provided for each. The basic shape of the family members is given for each key but the illustrations, while meant to be helpful, are on the small side and somewhat obscure.

Each species is identified by an excellent photograph of the imago at rest or feeding. A short, explanatory paragraph is provided for each photograph while size, habitat, larval foodplant, range, flight and similar species are listed below.

Joyce Alexander

Dinosaurs: the textbook

SPENCER G. LUCAS

Wm. C. Brown, Dubuque, 1994, 290 pp., softback with many black and white Illustrations. ISBN 0 697 14429 1, £18.95.

Despite the sensational coloured illustration of a rampant *Deinonychus* on its front cover this is a serious textbook based on the author's semester-long course at the University of New Mexico. In common with other contemporary American texts, it assumes little or no previous knowledge of its subject and all technical terms are fully explained either in the text or in the glossary at the end.

After first defining dinosaurs the opening chapters summarise the basics of evolution, phylogeny, classification and geology and these are followed by accounts of anatomy and systematics to family level. The remaining sections consider diverse topics including the environmental conditions during the dinosaur epoch, the history of dinosaur discoveries, whether they were hot- or cold-blooded and the origin of birds.

The work is profusely illustrated with excellent line drawings of dinosaurs and their parts and there are numerous cladograms showing taxonomic affinities. Additional information is provided in numerous "boxes" inserted into the text.

Criticisms are few: references following chapters are rather scanty, the formula for calculating the surface area of a sphere (p. 228) is wrong and the section on dinosaurs in fiction seems over-long.

The book is highly recommended for anybody with a serious interest in the subject.

Ronald M. Dobson

The Chiffchaff (Hamlyn Species Guide)

PETER CLEMENT

Hamlyn, London, 1995, 126 pp., softback with numerous colour plates and black and white illustrations.
ISBN 0 600 57978 6, £12.99.

This book offers the reader a detailed study of the Chiffchaff. Following a general introduction to the species is a chapter devoted to the identification of the Chiffchaff group with particular reference to the differences between similar species. The chapters on the distribution of the various races and migration contain many facts for the serious student. Of more general interest is the information on wintering in Britain, habitat, feeding and breeding behaviour.

The author suggests that, on the whole, human activity does not appear to pose too great a threat to this species, particularly with the growing awareness of the need to conserve mixed woodlands.

With a pleasing format the book has plenty of good illustrations which include colour photographs by Norman Arlott, and black and white pictures by Mark Andrews. Useful maps and graphs are included along with a bibliography, an index and an appendix of scientific bird names used in the text. A large amount of information is provided for the price of £12.99.

Jane M. Christie

The Blackcap (Hamlyn Species Guide)

C.F. MASON

Hamlyn, London, 1995, 126 pp., softback with numerous colour plates and black and white illustrations.
ISBN 0 600 58006 7 £12.99.

This eighth in the Hamlyn Series Guides gives a systematic and critical account of the Blackcap, a warbler which, unlike so many of our songbirds, has been increasing in the British Isles in recent years. Many migrate from western Austria to winter in our gardens! The Blackcap's characteristics and behaviour are compared with other Sylvia warblers, notably Garden Warbler, Whitethroat and Lesser Whitethroat. Many facts are readably presented and I found the discussion of evolution in relation to genetics and migration particularly interesting.

Norman R. Grist

Irish Birds (Collins Guide)

DAVID CABOT

Harper Collins, London, 1995, 224 pp., softback with many illustrations. ISBN 0 00 220023 6, £7.99.

This is a useful beginners' guide to the commoner species of birds to be found in Ireland, with a gazetteer of places to visit. There is a great deal of useful information, though, as the author himself points out in the introduction, the habitat divisions chosen do not necessarily reflect where birds may be found. The blackbird is widely scattered in habitat and its allocation to "Gardens, Parks and Buildings" reflects the habitat where most people are most likely to see the bird. A bird list arranged systematically by family might have been preferable but habitat arrangement is more meaningful to the general observer.

There is much of interest e.g. the roost of Pied Wagtails noted in O'Connell Street, Dublin; also the summer movement of birds between the mainland and Ireland. Comparative drawings of Terns and small gulls are useful, so too the silhouettes of raptors on the wing.

This is a good book for those starting bird watching and a good point is the provision of Irish Gaelic names along with the Common and Latin names of the birds illustrated.

Brian S. Skillen

Collins Atlas of Bird Migration

JONATHAN ELPHICK, General Editor

Harper Collins, London, 1995, 180 pp., hardback with numerous colour photographs, paintings and maps.
ISBN 0 00 220038 4, £16.99.

For those interested in migrant birds and the mechanics of migration, this book is an excellent introduction. Migrants from various parts of the world are reviewed, along with the routes they take, as are the migrant bird families such as Geese, Waders and Thrushes. There are sections on subjects such as flight techniques and hunting pressure on migrants which add to the basic data. All sections are well illustrated with photos and paintings in full colour. A book worth having, and at a reasonable price.

Bernard Zonfrillo

The Pocket Guide to Birds of Britain and Europe

MARTIN WALTERS

Dragon's World, London, 1995, 160 pp., softback with many colour illustrations. ISBN 1 85028 363 X, £7.95.

It is hard to understand the justification for producing yet another "beginners guide" to the birds of Britain and Europe. There are many such books on an already overloaded market. This one has little that is new to recommend it. Only adult male birds are illustrated and the vast majority are in summer plumage. The range of birds from all parts of Europe will help confuse the novice as much as some of the plumages of, for example, juvenile gulls, which are mentioned but not illustrated. The illustrations are not particularly good. At the price, a more comprehensive field guide could be purchased which would probably be of better use for the novice.

Bernard Zonfrillo

Bird Nests

SHARON A. COHEN (With photographs by GERRY ELLIS and others)

Collins, San Francisco, 1993, 128 pp., hardback with colour illustrations. ISBN 0 00 255110 1, £6.99.

This book is designed for the American and Canadian market. It is well written and easy to read and would not be out of place in the non-fiction section of a children's library. The colour photographs are of excellent quality. The work covers courtship and mating, nest building, defence of eggs, care of chicks and adaptation to the environment. There are interesting sections on altricial and precocial chicks. Nests ranging from simple scrapes to complicated structures are well described. The section on the confidence tricks employed in order to dupe foster parents into rearing changelings is fascinating.Although many of the birds discussed may be unfamiliar to the British general reader this pocket sized book is worthy of perusal.

Margaret M.H. Lyth

Mammals of Britain and Europe

A.M. HUTSON (With illustrations by JOANNA BROOKER, JIM CHANNELL, SEAN MILNE and JULIA PEWSEY)

Dragon's World, London 1995, 184 pp., softback with coloured illustrations. ISBN 1 85028 224 2, £7.95.

This is a truly pocket-sized nature guide in a sturdy spiral-bound weatherproof cover which describes 165 of the more common mammals of Europe. The text gives a comprehensive introduction to mammals ranging from tiny shrews to the mighty whales of the Atlantic. The area covered ranges from Ireland to the Urals and from Lapland to Gibraltar. Each species is dealt with under the following headings: size, weight, identification, range, habitat, behaviour, breeding, food, and similar species. Although the book claims that footprint diagrams are given to help identify animal tracks, most species are lacking this information. I would have liked to see more information on tracks and signs. There is a conservation theme running through the publication which is underlined by the publishers donating 1% of the royalties to the Royal Society for Nature Conservation.

In conclusion I consider the publication to be a good buy at £7.95.

Iain C. McCallum

European Mammals: Evolution and Behaviour

DAVID MACDONALD (Illustrated by PRISCILLA BARRETT)

Harper Collins, London, 1995, 352 pp., hardback with numerous line drawings. ISBN 0 00 21944 0, £14.99.

This book, by a co-author of the companion volume, *Collins Field Guide to Mammals of Britain and Europe*, is packed with interesting information from cover to cover and this reviewer found it almost impossible to put down. Many different aspects are considered and, although the title refers to European Mammals, coverage is much broader with many examples taken from further afield thus: Long-nosed Armadillos routinely produce identical quads from each fertilised egg; sex ratios amongst the progeny of presidents of the USA resemble those of high-ranking spider monkeys.

The book is written in a precise but user-friendly non-technical style, although the appreciation of some arguments may need careful thought. References are confined to a few general titles at the end, and though it is appreciated that a detailed bibliography would be impracticable, some guidance on further reading would have been welcomed after each chapter. Slips are rare e.g.: ha^2 appears several times as a unit of area. The line drawings, with the exception of the maps on p.314, are delightful.

The author and illustrator are to be congratulated on a most informative and useful production.

Ronald M. Dobson

Wild Otters: predation and populations

HANS KRUUK

Oxford University Press, Oxford, 1995, 290 pp., hardback with many figures, photographs and line drawings. ISBN 0 19 854070 1, £30.00.

Hans Kruuk has been responsible for earlier classic studies on hyenas, badgers and other carnivores. For over ten years he and his co-workers have been working on otters, mainly in Shetland but with shorter periods of study on other otter species from around the world. This book is a summary of their intensive researches. The otter is in serious decline in Britain and elsewhere in Europe, and the Scottish Highlands remain one of the few strongholds of the species in Europe. The study provides the most detailed information available on the requirements of otters and is an invaluable contribution to their conservation. The book covers all the main aspects of otter behaviour, with chapters on their social organisation and territory requirements and social behaviour. The sections on diet, their methods of catching fish and strategies for foraging are particularly detailed and important. Otters need an unusually large amount of food for a carnivore, and they are very selective in the types of prey that they take.

The book discusses their strategies for feeding and includes detailed descriptions of how otters find food and the energy cost of diving, which increases considerably as the temperature drops, when diving time has to be kept very short. Otters lose heat quickly in cold sea-water, and need regularly to wash the salt out of their fur in pools of fresh water. There are further chapters on the population dynamics of otters and detailed discussion of the conservation problems that they face. As one would expect from the author, the book is far from a dry scientific account. It is written in a delightful style, which conveys the author's obvious love for his animals. I would consider it one of the most informative and fascinating books I have read for many years. The text is enlivened with many photographs, clear diagrams and some delightful line drawings by Diana Brown.

David C. Houston

Collins Checkbook Series

British Butterflies and Moths ISBN 0 00 220020 1

British Birds ISBN 0 00 220022 8

British Wildflowers ISBN 0 00 220021 X

British Trees ISBN 0 00 220019 8

Compiled by MICHAEL CHINERY

Harper Collins, London, 1995, each around 200 pp., softback with many colour illustrations. Each £4.99.

These books (currently four in the series) are intended to enable users to keep a personalised record of all the Birds/ Butterflies and Moths/Trees and Wildflowers that they see. 200 species are illustrated in all but the Trees book (150 species) by means of (tiny) photographs and space is provided beside each photo, in which one is encouraged to log e.g. date of sighting, numbers seen, locality, habitat activity and all time records.

As with some other publications of this type which I have seen, scant consideration has been given, it seems, to the feasibility of making these observations in a total area of less than the back of the average matchbox. However, I must say that a well used copy of, for instance, the Butterflies and Moths book, might yield good information to the County Recorder or equivalent in terms of species distribution and other factors.

As well as collecting the whole series (at a cost of £20.00 less the obligatory 4p), the budding naturalist is warned DON'T LEAVE HOME WITHOUT IT!... The checkbook format does make the books more portable than the average field guide but to me the construction leaves something to be desired. A few weeks in my hands and the paper cover would be off and the flimsy pages would be bound to leave their spiral home soon after.

It is unlikely that these books alone would enable one to identify a lot of the species covered as there just isn't enough information provided - whether in the photographs or the accompanying two lines of text. In the Birds book, for example, generally only males are illustrated of species in which the sexes differ. The only book in which the size of the photograph (in this case 4.5 x 4cm) is adequate to represent the species is the Butterflies and Moths one. As for telling the difference between a Clouded Yellow and a Berger's Clouded Yellow from the photographs, I leave that up to you!.

John Phillips

Books Received

The following titles were received too late to be reviewed in the present issue. Full reviews will be published in the Glasgow Naturalist for 1997.

Pondweeds of Great Britain and Ireland: BSBI Handbook No 8:
C.D. PRESTON
Botanical Society of the British Isles. ISBN 0 901158 24 0, £16.50

Collins Illustrated Checklist: Birds of Eastern Africa.
BER VAN PERLO
Harper Collins, 1995. ISBN 0 00 219937 8, £14.99.

PROCEEDINGS 1994

The chairman, place*, number present, lecturer's name, title of lecture and note of any exhibit are given for most meetings.

*BOB: Boyd Orr Building, Glasgow University
GMK: Art Gallery & Museum, Kelvingrove, Glasgow
UGBD: University of Glasgow, Botany Department

14 JANUARY

Prof. N.R. Grist, BOB, 47, The 25th Paisley International Colour Slide Exhibition, Natural History Section, Commentary by N. Tait, presented by Winifred Brown.

8 FEBRUARY

Prof. N.R. Grist, BOB, 50, Bernard Zonfrillo, Plants of Ailsa Craig.

22 FEBRUARY

Prof. N.R. Grist, BOB, 33, 64th AGM.

Reports were presented on activities during 1993, and elections were held resulting in the appointments on p 72. . Membership stands at 278, made up of 232 ordinary, 33 family, 4 school and 9 honorary members.8 evening meetings were held in BOB, an Exhibition and Social Evening in GMK. During the summer 23 excursions took place. The Annual Dinner was held in the Kelvin Park Lorne Hotel. There were three Council meetings and the Executive met informally as required.

8 MARCH

Prof. N.R. Grist, BOB, 56, Gillian McKnight, Wildlife Conservation on Farms.

15 MARCH

Visit to the Mitchell Library arranged by Ruth Dobson.

12 APRIL

Prof. N.R. Grist, BOB, 28, Richard Sutcliffe, Butterflies. Exhibit, List of Birds seen in Botanic Gardens.

10 MAY

Prof. N.R. Grist, BOB, 27, Prof. M.B. Wilkins, Are Plants Intelligent?

14 JUNE

Summer Social to Finlayston Estate, Langbank.
20 Excursions took place during the summer months.

30 SEPTEMBER

Prof. N.R. Grist, GMK, 45, Exhibition and Finger Buffet.

13 OCTOBER

Prof. N.R. Grist, BOB, 150, First BLB Open Lecture, Prof. G. Prance, Director of Kew, Plants of Amazonia.

5 NOVEMBER

Joint with BSE and BSBI, UGBD, Dr Frank Perring, The Wild Flowers of Mount Olympus.

8 NOVEMBER

Prof. N.R. Grist, BOB, 42, Stuart Gibson, Bird Watch Around the Hebrides, Display of Fungi.

29 NOVEMBER

Prof. N.R. Grist, BOB, 40, Members Slide Night organised by Bill Parkes. 10 members exhibited.

15 DECEMBER

Annual Dinner, Kelvin Park Lorne Hotel, followed by talk on Trinidad by Geoff Hancock.

PROCEEDINGS 1995

The Chairman, place*, number present, lecturer's name, title, and note of any exhibit are given for most meetings.

*BOB: Boyd Orr Building, Glasgow University
GKB: Graham Kerr Building, Glasgow University

10 JANUARY

Prof. N.R. Grist, BOB, 50, 26th Paisley International Colour Slide Exhibition, Natural History Section, Commentary N. Tait, presented by W. Brown.

14 FEBRUARY

Prof. N.R. Grist, BOB, Dr Patricia MacDonald, Scotland's Vegetation from the Air.

28 FEBRUARY

Prof. N.R. Grist, BOB, 52, 65th A.G.M.Reports were presented on activities during 1994 and elections held resulting in appointments as on p 72. 2 Honorary Members were elected. Membership stands at 271, made up of 230 ordinary, 25 family, 1 junior, 6 school and 9 honorary members. 9 evening meetings were held in BOB, an Exhibition Meeting and Buffet Supper in GMK, a visit to Mitchell Library, a summer social to Finlaystone Estate and the Annual Dinner in Kelvin Park Lorne Hotel. There were 3 Council Meetings and the Executive met informally as required.

14 MARCH

Prof. N.R. Grist, BOB, 66, Jean Stevenson, A Sustainable Future for the Great Wood of Caledon.

11 APRIL

Prof. N.R. Grist, BOB, 40, Richard Sutcliffe, Pike, Tope and Skate, Fish Tagging in Scotland.

9 MAY

Prof. N.R. Grist, BOB, 59, Derrick Warner, Glencoe, More Than a Massacre.

13 JUNE

Summer Social to Kelburn Estate, Fairlie.20 Excursions were arranged for the summer months, 18 of which took place.

29 SEPTEMBER

GKB, Exhibition and Wine and Cheese. 11 Exhibits.

10 OCTOBER

Prof. N.R. Grist, BOB, 250, Dr J.H. Dickson, Otzi the Iceman's Last Journey: Clues From Plants, Goodfellow Lecture.

14 NOVEMBER

Prof. N.R. Grist, BOB, 35, Paul Walton, Birds of the Northern Isles.

28 NOVEMBER

Prof. N.R. Grist, BOB, 35, Members Slide Night. 10 members exhibited.

12 DECEMBER

Annual Dinner, Kelvin Lorne Hotel, 34, followed by talk on Turtles of Northern Cyprus by Andrew Kelly.

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Centre pages: Plates 1 and 2.

Back cover: Plate 3.

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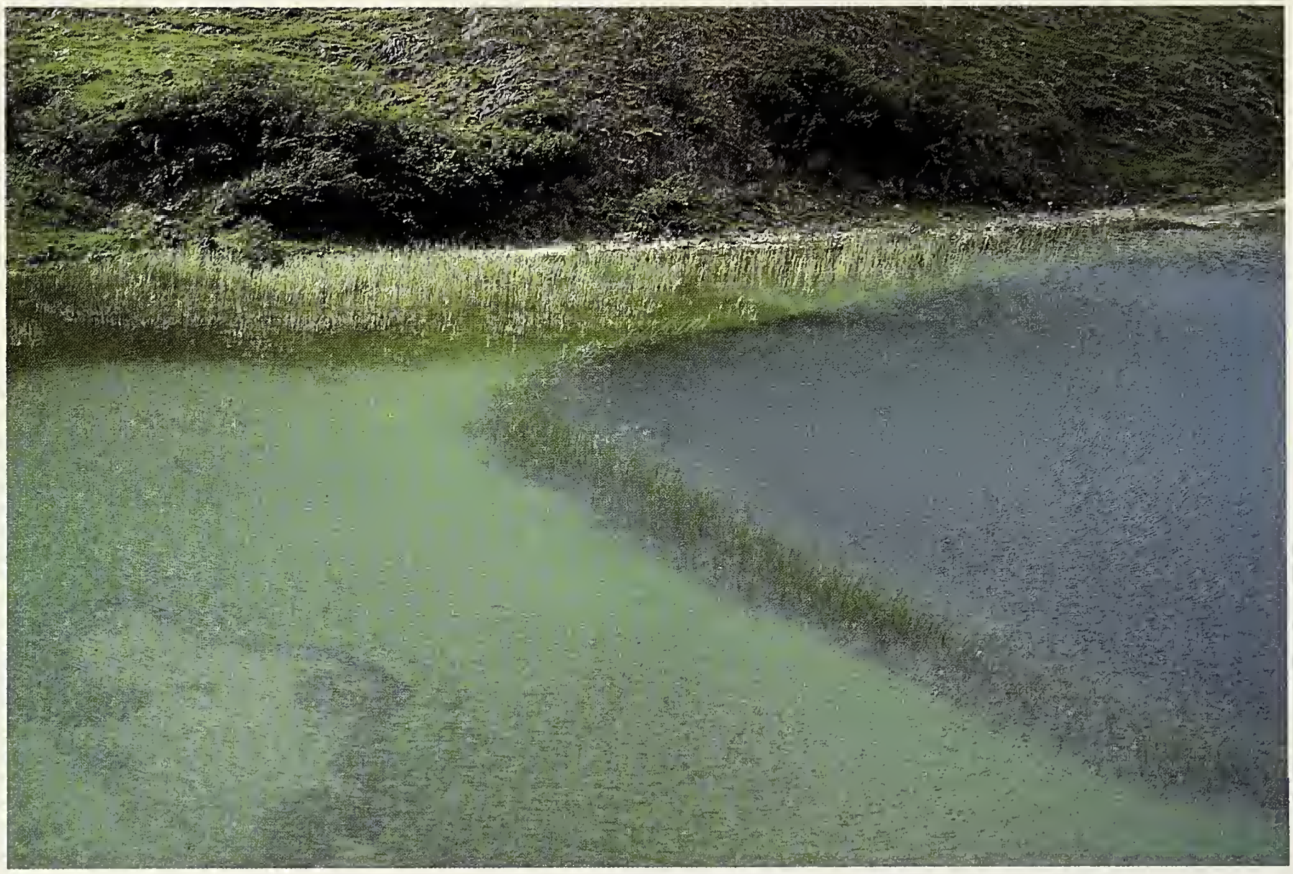

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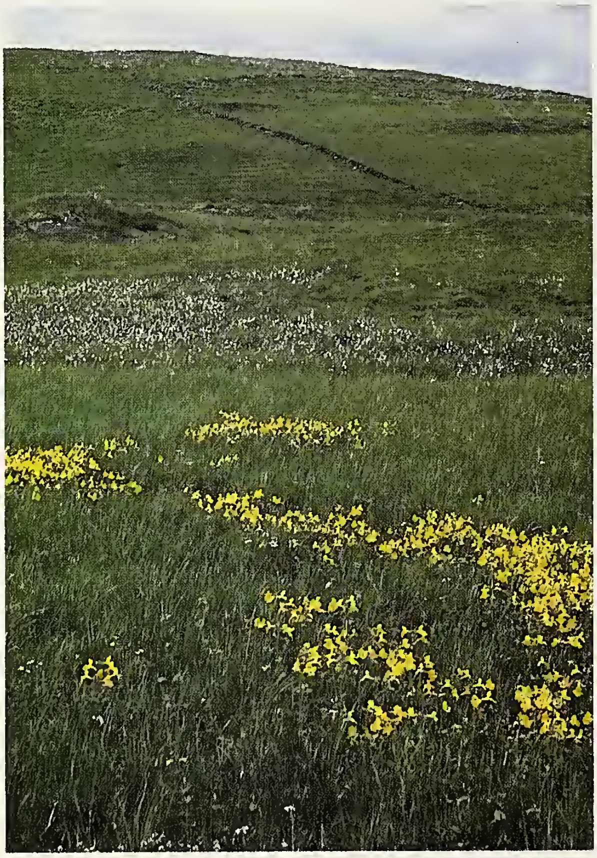
South end of Loch Fiart

Zoning of vegetation in the shallow water. The curving band of *Schoenoplectus* marks the edge of deeper water to right.



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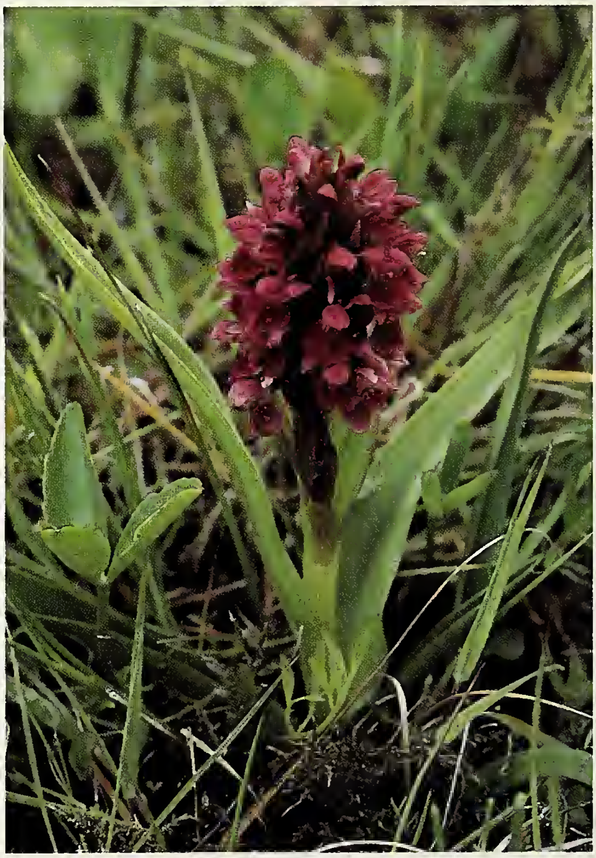
Monkeyflower *(Mimulus guttatus)*

These attractive flowers are not infrequent on Lismore, by streams and in marshes, but some are hybrids.



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Early Marsh Orchid

(Dactylorhiza incarnata* subsp. *coccinea)

This sub-species is a rare plant of calcareous flushes.

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The Glasgow Naturalist

Volume 23

Part 2 1997

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

THE GLASGOW NATURAL HISTORY SOCIETY
(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow or the Glasgow Art Gallery and Museum.

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EDITORIAL

Are the naturalists dying off?

Reed Noss's (1996) Editorial essay 'The naturalists are dying off' in the journal *Conservation Biology* is a worrying account of the state of natural history in the United States. His concern is that professional Conservation Biologists, themselves well-trained in their younger days in the skill and love of natural history, are not passing on their knowledge to the upcoming generation. This matters because "nothing will destroy the science and mission of conservation biology faster than a generation or two of biologists raised on dead facts and technology and lacking direct, personal experience with Nature". There are several reasons for this situation:

- field-courses have been heavily cut back (too expensive, too hazardous).

- natural history is regarded as low-level science, compared to molecular biology or information technology, so courses in biodiversity get cut.

- professional natural historians themselves get into the field too seldom (the burdens of administration take so much time; and fieldwork itself is chancy and time-consuming - it's easier to be successful in obtaining a grant for a short-term modelling study than for a new piece of fieldwork.

Noss's worries stimulated a large post-bag, mostly from colleagues agreeing with him (a selection was published as Bowen *et al.,* 1996). Since we tend to follow American trends, what is the situation here?

In our Universities, there are many courses whose titles include the words 'environment' or 'conservation', but few of these include detailed accounts of groups of plants and animals and their habits. The same is true of courses in Zoology and Botany (of which there are many fewer than there were). A modern science course emphasises the growth points of the subject, and may have little time for 'older' knowledge. For example, a Glasgow Zoology student meets the vast assemblage of invertebrate animals for the first time at third year level, and has no opportunity to study any particular group in greater depth. Field courses do exist, but are briefer than they were and always under threat because of their relatively high costs. Glasgow is fortunate in having excellent natural historians amongst the zoological and botanical staff, but most of these are near retirement. Since new appointments emphasise research potential, it will be a matter of chance whether new staff will be keen on fieldwork and natural history.

A few years ago, a House of Lords report alerted our science establishment to the disastrous decline in taxonomic teaching and research in the U.K. The Natural Environment Research Council's 'taxonomy initiative', part of it based in Glasgow, was the result. But taxonomy is not the same as natural history: scientists working on the classification of plants and animals may be primarily molecular biologists and mathematicians, rather than 'welly-boot' biologists.

One hopeful sign is the enthusiasm of students for expedition work. At Glasgow, the Exploration Society is extremely healthy in terms of student demand, and has done excellent work, such as the collection of several successive years data on turtle nesting in Cyprus. Even here, there is a worry: expeditions need staff interest and involvement, and that means staff whose own work takes them into the field.

Universities are only part of the story. In this country, a tradition of "amateur" interest in natural history has long flourished, and many of these amateurs have made vital contributions, from Gilbert White's "Natural History of Selborne" onwards. The success of the Collins "New Naturalist" series is one sign of the extent of this tradition, and natural history publishing as a whole is burgeoning with new books (see our Book Reviews section). Broadcasting also taps this interest, with ever more detailed accounts of the lives of plants and animals from all over the world. Then there are the societies for those whose enthusiasm for natural history takes them beyond watching the latest Attenborough series, or taking a few Collins Guides on holiday. Societies may specialise, like the Botanical Society of the British Isles, or emphasise conservation, like the Scottish Wildlife Trust, or they may generalise, like Glasgow Natural History Society.

A natural historian studying these societies as if they were species would worry that many are about to become extinct: declining numbers, most members very old, little sign of new blood. There are exceptions: the Royal Society for the Protection of Birds and the Scottish Wildlife Trust have youth arms (YOC and Watch Club respectively) run mainly by enthusiastic volunteers but, like most organised groups for young people, it is hard to retain members into the teenage years, with all the distractions young people are subject to these days.

To me, all this adds up to a worry: we have a lot of low-level interest and sympathy concerning wildlife, but this is not being converted into the deeper knowledge and understanding on which progress in our understanding of the living world depends. This matters, as Reed Noss noted, not only because a civilised society is a knowledgeable society, but because the conservation of wildlife depends on the advocacy and abilities of those who know and care about it.

The answer, as for many of society's ills, lies in some sort of educational policy, aimed at deepening the understanding of natural history in young and old. Universities, Museums and Natural History Societies can all have a role, but none of these are in good shape: funding cut-backs beset our Museums and Universities; ageing afflicts our Natural History societies. Recognition of the fact that a problem exists will be a help, but imaginative initiatives are necessary if a long tradition of knowledge is not to be lost. I hope Glasgow Natural History Society will rise to the challenge: action will be needed for natural history to move strongly into the next millennium.

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Roger Downie

GLASGOW NATURALIST Vol. 23 Part 2 pp 2-4 (1997)

SNAKES AND LADDERS
Depicting Evolution: Conceptions and Preconceptions

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"I thought it was a stupid prank. I'm in charge of this notice board, you know. It's my responsibility to organise it".

'Biology in the news' says the sign above the notice board in the foyer of the Division of Environmental and Evolutionary Biology. Clutching the screwed remains of my notice which had half a minute previously been ripped off the board and discarded, I asked, incredulous and stroppy, if The Organiser alone had permission to post items. Apparently not, which is probably as well because I had in the past pinned up the odd item myself: a picture of a two-headed snake from an Asian newspaper which I had found wrapping some chillies. And the one that I had now picked off the floor at The Organiser's feet. The snake (an arresting and slightly disturbing picture, but a developmental hiccup of minor biological significance; the script, Hindi I think, was lovely though) had remained on the board for about a year. The one now in my hand had survived only three weeks before I stumbled upon the process of it being Organised away. It was a request for votes in response to the largest and boldest item on the board, a colour two-page spread from 'The Times' magazine which greets DEEB staff, students and visitors each morning as it has for over a year and a half. 'Please Vote' I had printed, 'Do you think that this picture is a useful representation of evolutionary history?'. Boxes were provided for ticks, labelled 'yes', 'no, and 'undecided'. A pen hung up on a string.

The picture from 'The Times' is one that must be familiar, in generic form, to virtually everyone in the western world. At the far left, an early multicellular organism of curious structure, suggested as a possible ancestor of the backboned animals. Next (a considerable leap here, but the direction is the same as in all such representations) comes the sail-backed *Dimetrodon*, an early reptile belonging to a group believed to be ancestral to mammals. Then a rather more mammal-like reptile, followed by a couple of 'primitive' mammals. Next, in order, a tree shrew (representing a primate ancestor), an early primate (rather like a modern bush-baby), an ape, and then a stooping and disreputable-looking Australopithecine. This sequence goes from early and small at the left and sweeps right across the double page and upwards to the culmination: erect man, *Homo erectus*, the precursor of modern humans. Walks tall, walks straight and looks the world right in the eye.

As often seems to be the case in these pictures, scale is deeply compromised. *Dimetrodon* has shrunk, tree shrew has expanded. Physical scale is binned: it seems that such sacrifice is acceptable in formulating the illusion of a 'forward and upward' evolutionary progression towards humanity. I'm not the first to note that when people fabricate their icons, accuracy takes a back seat. Similarly, I'm not the first to question this icon in particular: far from it, indeed in certain circles a coherent dogma has developed around admonishing perpetrators of this *faux pas* of evolutionary biology. Leading the way (being currently one of the most famous biologists in the world, and certainly one of the most verbose) is Stephen Jay Gould. The argument is as follows: evolution does not progress as a ladder with humanity occupying the uppermost rung, or as a march of increasing virtue towards the human condition. Gould's preferred metaphor is the 'luxuriant bush'. Multitudinous branches, born in speciation and pruned by extinction, radiate in a verdant tangle of diversity. The ladder icon not only fails to recognise this pattern, but it falsely gives the impression of progress towards a human end-point. The modern bush-baby (which, in Gould's view, it seems we all are) mentioned above is 'as evolved' as a human: its lineage is as old, and like us it is the living descendant of the survivors of natural selection. One could with equal (equally weak) justification create a similar icon with this cuddly wide-eyed fur ball at the apex: an iconic history of cute, if you like. The real problem, however, becomes manifest when this misleading representation is combined with the human predilection for hierarchical thinking. From the ladder comes the idea of progress, of the 'new and more human' replacing the 'old and primitive'. As is borne-out by the many examples hunted down by Gould, it has proved all too easy to slot in, despite the vacuous absence of scientific justification, 'African' behind 'European, or 'Jew' behind 'Aryan'. And of course, perhaps most insidious of all, always behind the human comes the entire non-human population of the planet.

Why, then, given the difficulties outlined above, has this representation of evolution become a fixture of our cultural life? Gould's writing on the subject gives the impression that the blame lies squarely with the aforementioned hierarchical organisation of much human thought: that the misrepresentation of history results from an attempt to accommodate preconceived ideas of what is 'primitive' and 'bad' and what is 'advanced' and 'good' in an evolutionary context. Through his typically exhaustive and erudite collection of examples, one can clearly see this effect in operation. There is another factor, however, which appears to have been overlooked in a case of 'not seeing the wood for the trees': simply, that people have an inordinate fascination for their ancestors.

The picture which dominates the notice board in the foyer accompanies an article about human ancestors. Each of the steps on the evolutionary 'march' is a representation of what, given a fairly scientific guess, various animals on the direct human lineage might have looked like. They are impressions of our ancestors. The editor of that magazine understood that we all want to see, touch, the ancestors. Now, a writer as venerable as Gould, perhaps, would at this point embark on a passionate and detailed treatise on the pervasive cross-cultural nature of the human obsession with ancestors. As it is, I find little half-known snippets of information gleaned from half-forgotten sources jumping into my head: Japanese religion, American Indian culture, talks told to Bakka children, my own father telling me of our family history. I am clearly not Gould. However, this is in one way a blessing because it does present an opportunity to use the man himself as an example of just how powerfully attractive the idea of direct lineage can be.

The undeniably lofty position that Gould occupies amongst biologists (I am told that when he visits here the sycophants come out of the woodwork: would probably be there myself, given the chance) comes at a price. There is a steady stream of creationist dogma to be addressed and he is in the front line. With characteristic vigour and stamina, creationists continually point to the paucity in the fossil record of intermediate forms between one distinctive group and another, point to links that are missing. If, as evolutionary biologists claim, whales developed from terrestrial four legged mammals via the slow grinding of natural selection, surely one should find evidence of animals which occupied the extensive structural middle ground between these forms. However, with some notable exceptions, few 'intermediate' fossils have been found. Gould's stance in this argument is unambiguous. He is champion, indeed co-perpetrator, of the idea that the norm in nature is for extended periods of stasis (forms changing little with time) punctuated by short bursts of rapid evolutionary change in small, peripheral and geographically isolated populations. Any effective innovations thus arising spread relatively quickly via successful reproduction and colonisation, and the (famously patchy) fossil record is left with the observed pattern: the presence of one general form for extended periods and then the 'sudden' appearance of quite different forms. A scarcity of fossilised intermediates is precisely what one would expect under this scenario, and so invoking the creative intervention of a deity is rendered unnecessary.

In his latest collection of essays, Gould delights in the recent discovery in Pakistan of early whale fossils (Gould 1996). Palaeontological delight. I suspect that to him, holding a fossil is about as exciting as contact with an inanimate object can ever be, and I know exactly how he feels. The essay positively brims over with excitement, articulated gloriously. The palaeontologists in Pakistan have found a whole range of intermediate forms between terrestrial quadrupeds and whales, all in exquisite sequence from the shallows guddler to the consummate diver of blue-black depths. And as ever, I delight in his delight. However my own is, unfortunately, tempered. I see the punctuated equilibria of evolution. I see the luxuriant bush. And to me, the chances that these fossils are the remains of animals on the direct whale lineage depend precisely on just how luxuriant the bush actually was. Which we do not know. Could these 'perfect intermediates' actually be representatives of extinct lineages? Of course they could. And, as Gould has adopted the more 'luxuriant' position on these things (Gould 1989), one might expect him to concentrate somewhat more on this possibility. So why has he not? Why does he directly infer information on the mechanics of the terrestrial-aquatic transition based on these fossils? Is it because such a transition is an impossible mystery that thirsts for any pointers as to an explanation? This would seem unlikely: assuming (as, it could be argued in his own logic, he should) that these are perhaps not actually ancestral whales, then as much if not more could surely be learned from living animals that are also not ancestral to modern whales, but which are semi-aquatic mammals, e.g. otters and seals. Or, could it simply be that after years of explaining to the creationists why the fossil record is not actually at odds with evolutionary theory, a rare chance to stick up the fingers and say 'there's your intermediate form, pal' was too good to miss? Well, maybe, but I don't think so. This essay is not an attack on Gould. Some have criticised him for allowing his emotions and politics to obscure objectivity. I for one find it impossible to feel anything but admiration and friendliness towards someone with such burning fascination for the natural world. And to me, Gould's piece is really about this fire: an ode to the thrill of the direct lineage. He knows, and indeed pays lip service to the idea, that these fossils might well represent 'failed' phylogenies, but the finds are so subjectively convincing that the excitement is too much to conceal. The idea that we now hold in our hands the ancestors of whales.

Gould is a professional palaeontologist. The discovery of evidence relating to the evolution of a group that interests him led to him forsaking, lightly and temporarily, the philosophy that forms that backbone of his general ideas on the history of life. Most people are not professional palaeontologists. The group that really interests them is, of course, *Homo*. When the subject of evolution arises, the call is for a peek at the ancestors. Authors, dutifully aiming to satisfy, attempt to recreate the direct human lineage, replete with images of 'granddad, the monkey', 'great granddad, the slime mould' (accuracy sitting quietly in its place on the back seat). Sadly, the philosophy of equality in diversity is (one hopes lightly and temporarily) forsaken in the resulting image. However, if an icon which graphically touts our animal origins is accepted and propagated by society, perhaps a loss of perspective and accuracy is acceptable, even a historical necessity. Can we forget that in the richest country in the world, in 'the land of the free', legions of people still see the very idea of evolution as blasphemous, the notion of humans having animal origins, anathema?

Allow me to return to the notice board in our foyer. Imbued, involuntarily, with the above thoughts, and seeing the famous 'icon' every working morning for many months, I felt compelled to come to some sort of decision as to my own stance on this matter. True to form, I boldly decided that I was undecided. And being so, naturally the next step was to wonder how others working in the Division felt on this issue. Hence the request for votes. In the increasingly competitive atmosphere of scientific institutions, researchers have understandably become increasingly embroiled in their own narrow fields. Consequently there is, in our Division, surprisingly little interchange on the wider evolutionary issues, and I find this frustrating. I want to discuss and learn about macro-evolution. With the notice, I had hoped to induce some discussion. Stupid, perhaps, but not a prank. And the votes? Do people working and studying in the Division think that the picture is a useful representation of evolutionary history? In the three weeks, ten people voted: six 'no's, three 'undecided', one 'yes'. Couldn't decide whether I should vote myself, and so I didn't. If I had, it would have been undecided. Probably.

Writing is a most effective catharsis, and I am no longer indignant at the summary scrapping of my notice. All our opinions and beliefs are formed by our experience of, and interaction with, the people around us. Unsurprisingly, then, I see in myself now a small but decisive change in my personal view of the problem that is the theme of this essay. The Organiser is not an unkind man. Nor is he an egotist, or a bigot. On the contrary, he is actually a gentle and interesting man, and if hard work, creativity and rigor are the hallmarks of a good scientist, then he is clearly very good indeed. Furthermore, I can thank him for galvanising, albeit (no doubt) temporarily, my own indecisive thinking on the icon. The remark that opens this essay was indeed made in exactly those words, but the tone of his speech is important: he spoke softly, almost apologetically. He really did think that it was a prank. Perhaps I flatter myself, but I had at the time, and still have, a feeling that he wanted to apologise for a judgement made in haste (The Organiser is one of the busiest people in this building). Nonetheless, he did not. Something stopped him, and I think I know what it was: the hierarchy of status which dominates academia. He is Lecturer, I am student. People's heads are full of ladders. These days I'll stand behind Gould and defy them. Now, my vote would be no.

I am a healthy, white, middle-class, protestant male in higher education, surely one of the most over-privileged and cosseted people on the face of the earth. And this microscopic, utterly trivial injustice was enough to push me into the 'get the bush right, accommodate the diversity, or don't bother at all' school of thought. Gould is a Jew. Much of his writing I like, large portions I do not: often, I cannot help seeing snobbishness and false modesty in the work. But his greatest (I use the word carefully and earnestly) work, for me, is his mercurial annihilation of scientific racism and negative eugenics. On Auschwitz, the Third Reich, the use of science to justify murder or sterilisation, Gould's words form a terrible blossom: steely logic pouring from a man's heart. Let him topple the ladders in people's heads. Perhaps he can see where they ultimately lead.

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COLONISATION OF AN URBAN HABITAT - NATIVE ORCHIDS ON THE UNIVERSITY OF GLASGOW CAMPUS

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ABSTRACT

Three native orchid species are currently growing on the University of Glasgow campus: *Epipactis helleborine* - the Broad-leaved Helleborine; *Dactylorhiza fuchsii* - the Common Spotted-orchid; and *Platanthera chlorantha* - the Greater Butterfly-orchid. Using molecular genetic techniques, we show that at least one of these - the Broad-leaved Helleborine has not become established from a single seed, and is instead the result of multiple immigrants.

INTRODUCTION

The Orchidaceae is one of the most species rich families of all flowering plants, with estimates ranging from between 12,000 and 30,000 species (Sanford, 1974). From this diverse family, 28 species from 15 genera occur in Scotland (Allan & Woods, 1993), and these species grow in a wide range of habitats including woodlands, grassland, mires, heaths, dune systems, and marshes. As well as growing in these semi-natural habitats, some orchids are capable of colonising sites in urban areas, and Dickson (1991) listed nine orchid species that grow in and around the city of Glasgow. Of these nine species, three occur within 100 metres of the Bower (Botany) Building on the University of Glasgow campus, namely *Epipactis helleborine* (L.) Crantz - the Broad-leaved Helleborine; *Dactylorhiza fuchsii* (Druce) Soú - the Common Spotted-orchid; and *Platanthera chlorantha* (Custer) Reichenbach - the Greater Butterfly-orchid.

SPECIES ACCOUNTS

Epipactis helleborine

The Broad-leaved Helleborine is a widespread perennial species that is typically associated with shaded woodland margins and rides. It is, however, tolerant of a wide range of edaphic conditions and can occur on a diverse array of soil types from limestone and marl, to oxidised peat bogs (McKendrick & Dickson, 1994), and its ability to colonise new habitats such as poplar plantations, gardens, roadsides and railway ditches is well documented (Adamowski & Conti, 1991; Brunton, 1986; Dickson, 1990).

Epipactis helleborine has been well studied in and around Glasgow, and it occurs in 47 of the 90 tetrads (4 square Km) that make up the Glasgow area (Flora of Glasgow survey - unpublished data). It can be found here in a number of habitats including gardens, parks, cemeteries, golf courses, woodlands, scrub, mine spoil heaps, lime dumps, roadside verges and railway embankments, although it appears to be restricted to soils of pH5 and upwards. Its distribution in the Glasgow area is shown in Fig. 1a, and its scarcity in the north east of the region is striking. McKendrick & Dickson (1994) suggested that this may be due to a combination of factors including the generally more acidic soils and greater amount of agricultural land present in this area reducing the amount of suitable habitat.

The population of *Epipactis helleborine* on the University of Glasgow campus is well established, and the plant has been known here for at least ten years. It is by far the most abundant orchid on the University campus, and in 1996 over 100 individuals in total were found concentrated on the grassy area between the Botany Gate and the Main Gate (NS/567-8.667), and in the borders by the fence eastwards from the Main Gate (NS/569-70.666-7). Spraying of the latter population with weedkiller in 1995 appeared to have little or no effect on the plant's abundance in 1996.

Dactylorhiza fuchsii

The Common Spotted-orchid is, again, a widespread variable species that can be found in a variety of habitats, although it prefers calcareous or neutral soils (Allan & Woods 1993). It is very common in Britain and has been recorded from all vice counties (Lang, 1989). Like the Broad-leaved Helleborine, it is not always associated with pristine semi-natural habitats, and can be found growing for instance on the verges of motorways and major trunk roads (Allan & Woods 1993).

Dactylorhiza fuchsii is abundant in Glasgow, and is the commonest orchid in the area (Dickson, 1991), where it occurs on mine spoil heaps, roadsides, disused railways, pasture, cemeteries, gardens and parks. It is recorded from 76 of the 90 tetrads that make up the Glasgow area (Flora of Glasgow survey - unpublished data), and is more widespread in the north-east of the region than *Epipactis helleborine* (Fig. 1b).

Dactylorhiza fuchsii, grows on the University campus close to the Bower Building, (NS/567.667) and was first noticed here in the 1990s. In 1996 there were seven flowering individuals that could be identified, along with another 20 non-flowering plants.

Platanthera chlorantha

The Greater Butterfly-orchid is common throughout Britain, and is absent from only 14 of the 112 vice-counties that make up England, Scotland and Wales (Allan & Woods, 1993). Its most common habitat is calcareous grassland but it can also be found on moorland, scrub, deciduous woodland and marshy areas (Allan & Woods, 1993).

The Greater Butterfly-orchid is known from eleven tetrads in the Glasgow area (Fig. 1c), where it is recorded from habitats such as golf courses, railway embankments and heathy ground (Dickson, 1991). Allan & Woods (1993) noted that Scottish populations of this species are rarely large, but there are of course exceptions to this rule and Dickson (1991)

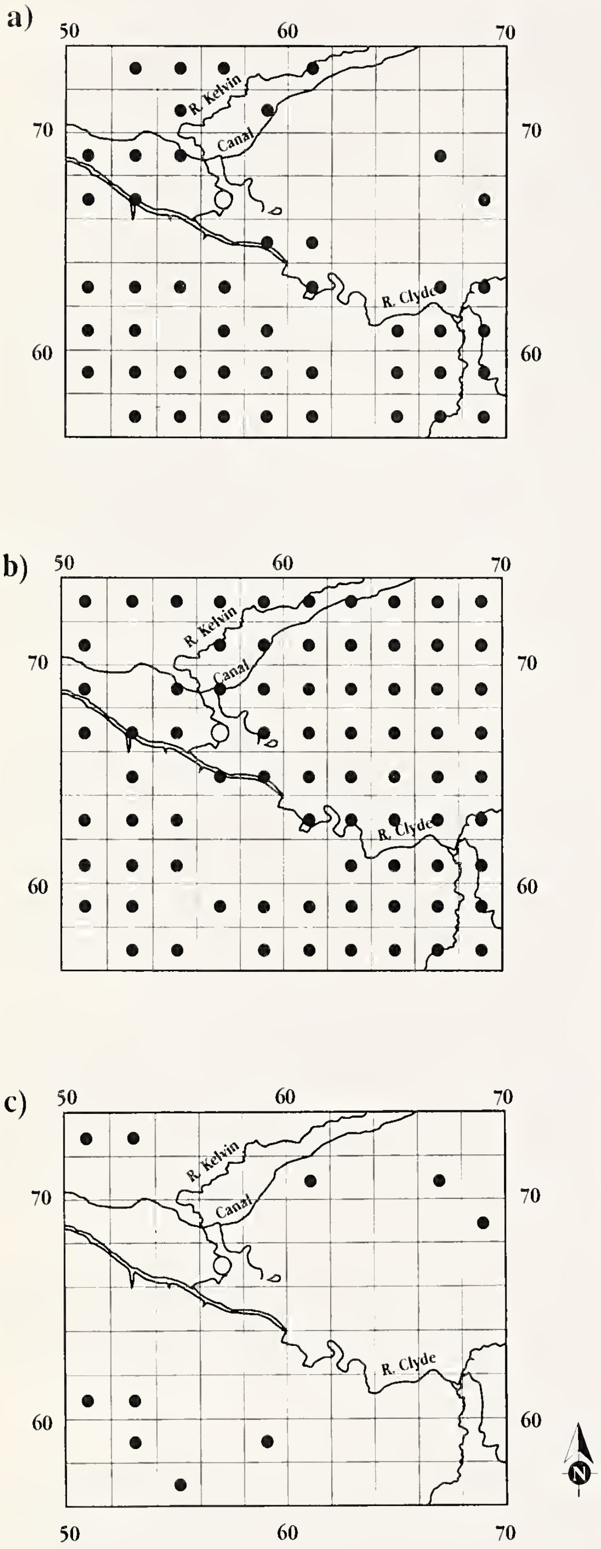


Figure 1.

Distribution maps of a) *Epipactis helleborine,* b) *Dactylorhiza fuchsii,* c) *Platanthera chlorantha* in the Glasgow area.

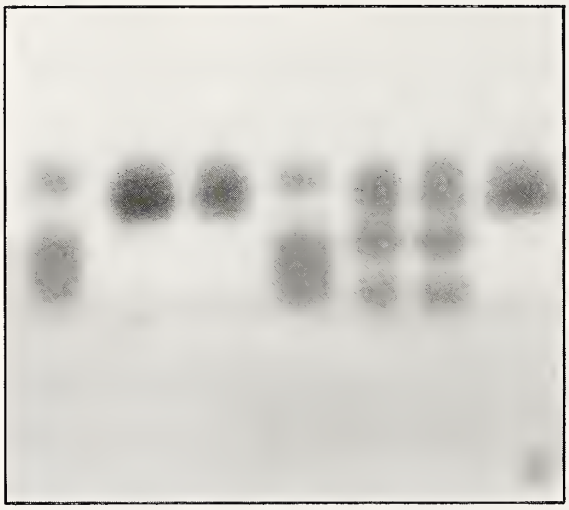
Each square is a 4 square kilometre (= tetrad) block based on the Ordnance Survey National Grid. A sample of grid lines (50, 60, 70) is labelled for reference.

Topographical features include the Rivers Clyde and Kelvin and the Forth and Clyde Canal.

Black circles denote the presence in a tetrad; the larger, lighter circle represents the campus populations.

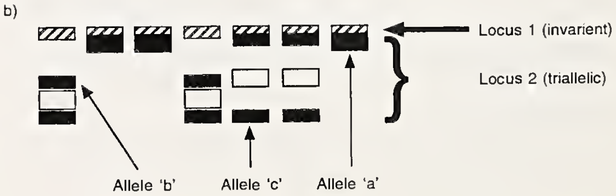
Figure 2.

a) Photograph of a starch gel of phosphoglucose isomerase (PGI). This gel shows products of two of the thirteen protein encoding genes studied in *Epipactis helleborine.* This gel shows seven representative samples from the population. One of the genes is uninformative, being invariant in all samples; the other shows triallelic intrapopulation variation, indicating multiple founders of the population.



b) Diagrammatic representation of Fig 2a.

The gel shows two PGI gene loci. The top gene (locus 1 - cross hatched) is invariant in all samples. The bottom gene (locus 2) shows variation among individuals, with three alleles (shaded black and designated a, b and c) present. The unshaded boxes indicate bands that are not forms of genes, but intermediate products formed by reassociation of the two polypeptide chains that make up each of the different alleles. A similar pattern of variation was found in another gene (not shown) namely MDH (malate dehydrogenase).



noted the presence of nearly 500 individuals at Cardowan in 1988.

Platanthera chlorantha, is the rarest of the three orchid species on the University of Glasgow campus, being represented by a single plant growing close to the security office at the main gate (NS/568.667). This individual was first brought to our attention by James Hartwell in 1996, and in that year its flowering spike reached a height of 38cm.

POPULATION BIOLOGY

Where there are multiple individuals of a species at a given site, such as the Broad-leaved Helleborine and the Common Spotted-orchid on the University campus, it is often impossible to tell by gross morphological features alone, whether they have become established from a single founding individual, or whether there has been multiple immigrants to the population. Molecular genetic techniques can, however, now offer powerful insights into the population biology of plants, and key microevolutionary processes such as gene flow and dispersal can be examined using data derived either directly or indirectly from DNA sequences (Avise, 1994). One such technique that can easily be employed for this purpose is starch gel electrophoresis of isozymes (Soltis & Soltis, 1989). The technique detects differences in the net charge of certain proteins in different individuals, by separating the proteins on a gel in the presence of an electrical current. The differences in charge of these proteins is caused by differences in the DNA sequence in their coding genes, and thus can be used to measure genetic similarities and differences among individuals, populations and species.

Any diploid individual usually carries two copies of these protein encoding genes, one inherited from either parent. If a population contains more than two different forms of a gene (more than two alleles), this suggests that the population has been founded by more than one individual (barring *de novo* mutations). Thus if a population of a diploid plant species carries three alleles for a given gene, it is likely that this is due to a minimum of two individuals migrating to the site by seed, or by the establishment of a single seed, followed by pollen import from other populations. If only two alleles for a given gene are found in a population, however, it is not possible to distinguish between multiple founders with the same genetic constitution or a single founding individual.

To investigate whether the populations on the campus have become established from a single individual plant in each species, we examined genetic variation in both *Epipactis helleborine* and *Dactylorhiza fuchsii,* (both of which are considered to be diploid species (Jones, 1974; Tanaka & Kamemoto, 1974). We examined 35 individuals of *Epipactis helleborine* and seven individuals of *Dactylorhiza fuchsii* for genetic variation at thirteen and ten protein encoding genes respectively, as described by Hollingsworth *et al.* (1995). The results for the Common Spotted-orchid were inconclusive with a maximum of two alleles for each gene being detected in the population. We were thus unable to distinguish between a single founding individual or multiple founders containing the same alleles. The results for the Broad-leaved Helleborine were more informative with three alleles being detected for two separate genes (e.g. Fig. 2). These alleles have all been found in a number of other populations so we can exclude these as being *de novo* mutations. We can thus conclude that the *Epipactis helleborine* population on the University of Glasgow campus has not become established from a single founding individual but rather is the product of either a minimum of two immigrants (as seeds) or a single individual followed by subsequent import of genetic diversity by pollen. Given the high levels of dispersibility of the small dust-like seeds of this species, the former is perhaps the most likely explanation.

ACKNOWLEDGEMENTS

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OXLIPS IN LANARKSHIRE

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While a right-of-way mapping survey was being carried out in 1982 by staff from the Leisure and Recreation Department of Hamilton District Council an unusual *Primula* species was noted on the bank of a stream (NS 79.50) which runs in a NNE direction to join the River Clyde near Dalserf, Lanarkshire (VC 77).

We instituted a search of the area and nine separate plants were detected, seven on the rocks just above the water-line and the others slightly higher on the grassy bank. The area in which the plants were detected extended over a length of about 50 yards beginning a short distance after a small waterfall.

We were confident that the plants were Oxlips *(Primula elatior)*. However as the main native sites are in East Anglia, where the plant occurs in woods on clay, a specimen and colour transparencies were sent to the University Botanic Garden, Cambridge. The identification was confirmed with the rider "It must have been planted (or at least accidentally introduced) in this Scottish site. People do grow it in gardens, but it is not commonly cultivated". (specimen now herbarium PM).

Information was sought regarding the gardens upstream and we were informed that Oxlips were grown in the large, semi-wild garden of Woodside House about half a mile from the site.

We have kept the water-side area under review. In 1996 there were still seven plants, most of which had spread vegetatively (we know that one of the original nine was dug up and transferred to a garden). Some are situated on projections into, or on bends in the stream, strongly suggesting deposition at these points (Plate 2). Others are growing out of cracks in the rocks in situations in which they could not have been planted. Those on the grassy banks may have been deposited when the burn was in spate.

Also in 1996 we discovered further plants along an abandoned railway line about 500 yards to the south of Woodside House. Enquiry at the house elicited the information that the plants on the old line had been transplanted earlier in the year by the owners "to brighten up the drab old track". Within the garden there are hundreds of plants from tiny to very thick clumps and we were informed that the Oxlips seed into the most unlikely places. The owners did not know of the downstream plants but they had only been in occupation for eight years.

We are confident however, that the burn-side plants are indeed the result of migration from the Woodside House garden. Further, we consider it important to put on record the nature of the introduction on the abandoned railway track.

DISCUSSION

Identification Features

Hopkirk (1813) wrote "The Cowslip is not found indigenous in the neighbourhood of Glasgow. From recent experiments made at Dalbeth, there seems no reason to doubt but that the Primula elatior is a hybrid between the vulgaris and the veris. From seeds of the P. veris which had been growing intermixed with the vulgaris, were produced plants answering entirely the description of P. elatior in Flor. Brit. The stalk many flowered, Corolla of some plants flat, of others inclined to be concave. Size and colour intermediate between the vulgaris and veris. Spots on the Corolla not distinct. Leaves wrinkled and dentated".

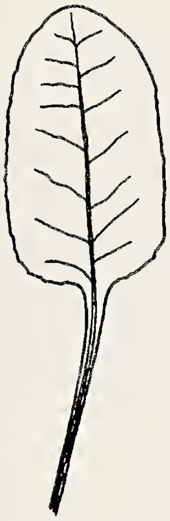
It is reasonable that Hopkirk should have considered *P. elatior* and *P. vulgaris x P. veris* to be identical. Modern floras all agree that the taxa are distinct, but on the whole do not give a clear indification of the distinguishing features. Further, one is largely left to assume the critical features of the above hybrid. Valentine (1975) and Stace (1991) state only that it is intermediate between the parents in leaf, flower and pubescent characters. With regard to the differences between the hybrid and *P. elatior* Stace (1991) just wrote that careful attention to leaves, flowers and pubescence is needed to avoid confusion. One is left with the problem of producing a chart of the relevant features of the different taxa in order to assess intermediacy and other differences. This we have attempted to do.

Leaves

In the typical *P. veris* the blade is abruptly contracted at its junction with the petiole (Fig.1), while in *P. vulgaris* the leaves are ovate-spathulate and gradually taper to the base (Fig. 2). In the hybrid the leaves are spathulate and although not usually contracted abruptly at the base can be very variable in this regard (Fig. 3a,b). *P. elatior* typically has leaves abruptly contracted at the base but they can also be tapered and may therefore be identical with those of the hybrid (Fig. 4a,b). These differences may be seen on the same plant. Figures 1-4 have all been drawn from plants whose identity has been confirmed.

Flowers

P. veris has flowers of a deep yellow, the corolla having folds in the throat. The hybrid has paler flowers although of a deeper yellow than those of *P. vulgaris* and some folds may be found in the throat. *P. elatior* has even paler flowers than the hybrid and never has throat folds. In *P. veris* the umbel is rather drooping with a tendency to do so to one side while the hybrid has flowers spreading on all sides. *P. elatior* also has the flowers rather drooping, but all to the one side. In our experience the hybrid has pedicels which are much longer than in either *P. veris* or *P. elatior*.



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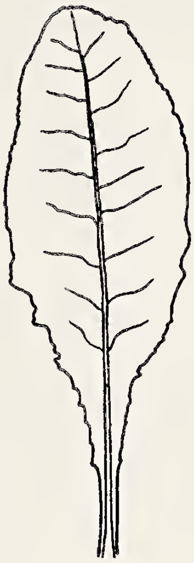

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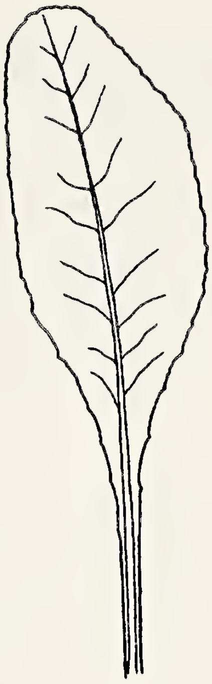

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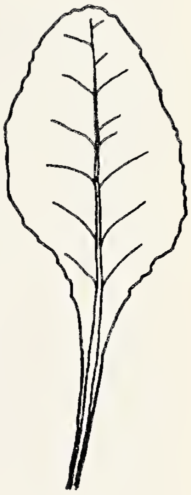

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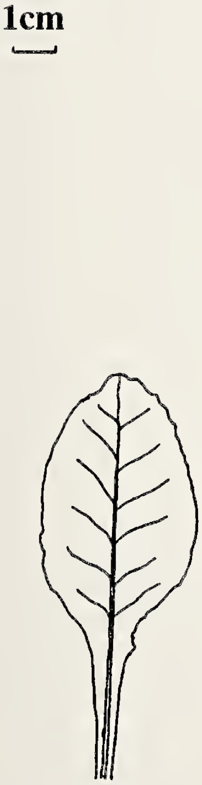
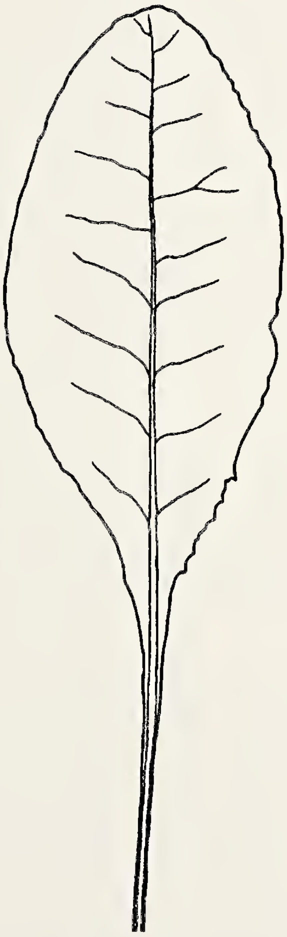


4a



4b

Figures 1-4

Leaf drawings all to same scale

1. Cowslip leaf abruptly contracted at base
2. Primrose leaf gradually tapering at base
3. *P. vulgaris* x *P. veris* leaves:
    a) gradually tapered at base
    b) ± abruptly tapered
4. Oxlip leaves:
    a) Lanarkshire plant ± abruptly tapered at base
    b) Cambridgeshire plant gradually tapered at base

Pubescence

Because *P. vulgaris* has long shaggy hairs and *P. veris* short fine ones, the hairs of the hybrid tend to be of moderate size. Those of *P. elatior* are short but curled.

Summary

P. elatior may therefore be differentiated from *P. vulgaris x P. veris* because it has pale yellow flowers which never have folds in the throat and the fact that it has a secund inflorescence with the unidirectional flowers on relatively short pedicels. The presence of crisped (curled) hairs is added evidence. We do not consider that reliance can be placed on leaf shape. Our specimens from the wild match completely the above criteria for *P. elatior.*

Herbarium Material (GL)

A review of the Primula specimens held in the Hopkirk Laboratory Herbarium, University of Glasgow has been undertaken by the senior author. There are three specimens from Scotland labelled *Primula elatior.* Two are from Fife (VC 85) and the third from Caithness (VC 109). Collection dates range from the mid 1800s to 1927. Taking into consideration the criteria outlined above it is considered that all are *P. vulgaris x P. veris* and as requested, a note to that effect has been added to the herbarium sheets. There are 11 specimens from England. Of these, seven are correctly named, come from appropriate vice-counties and have collection dates ranging from 1837 - 1910. However, the other four are from Bristol (VC 6 or 34), Worcester (VC 37), Cheshire (VC 58) and Mid-West Yorkshire (VC 64) with a date range from early 1800s to 1879. These already have footnotes suggesting the possibility that they are of hybrid origin as above, a fact endorsed by our criteria.

National Distribution

P. elatior is included in *Scarce Plants in Britain* (Stewart *et al.* 1994), the criteria for inclusion being plants which are recorded nationally in 16 - 100 10km squares. In addition to giving the native sites in East Anglia and Buckinghamshire, it records two sites of introduction in Great Britain, one in Cheviot (VC 68) and the other in West Lancashire (VC 60).

In *The flowering plants and ferns of North Lancashire* (Livermore & Livermore 1987) there is an entry "Garden escape, a single plant 47S". Silverdale, which covers most of 34.47S, is well known for its garden aliens, many of which probably originate from local nurseries. The recorder died a few years ago and there is no recent information about the plant.

The *Flora of Northumberland* (Swan 1993) records the occurrence of one patch, said to have neither increased nor decreased during the past 50 years, in a woodland glade near Hedgeley (Cheviot VC 68) and that the origin is unknown. Further, there were formerly two hortal sites in South Northumberland (VC 67), a field near Corbridge in 1930, origin unknown and near Bothal in 1974.

We know of no report of the plant occurring in the wild elsewhere in Scotland. The description of the only known extant site of introduction in England indicates that the plant may be classified as surviving (Macpherson *et al.* 1996) so that the Lanarkshire site would seem to be the only one in which *P. elatior* is established in Great Britain.

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THE ORIGIN OF *HYPOPTERYGIUM* POPULATIONS IN SOME EUROPEAN BOTANIC GARDENS, WITH SPECIAL REFERENCE TO *HYPOPTERYGIUM ATROTHECA* DIX.

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ABSTRACT

In the second half of the nineteenth century and, in particular, the first decades of the twentieth century many exotic moss species were accidently introduced in European botanic gardens. Several of these introduced mosses have been described as new species. Among them was *Hypopterygium atrotheca* Dix., which grows abundantly in the Glasgow Botanic Gardens.

The present study discusses the "true" origin of *H. atrotheca* and its possible relationships with *Hypopterygium*-species in the wild. *H. atrotheca* was almost certainly carried along with imported tree ferns and shows closest resemblance to Australian material of *H. muelleri*. The introduction of *H. atrotheca* and its "true" origin cannot be fully understood without knowledge of the horticultural history of ferns and the introduction of other *Hypopterygium*-species in European gardens. Hence, the relevant horticultural history of ferns is briefly discussed; the origin of some other, introduced *Hypopterygium*-populations and their relationships with species in the wild are treated as well. Three validly published taxa based on material collected in botanic gardens (*H. atrotheca, H. bouvetti, H. rigidulum spp. balantii)* and a few *nomina nuda* are reduced to *H. muelleri. H. immigrans* is also proposed in the synonymy of the latter.

INTRODUCTION

On Monday August 5th, 1996, participants of the British Bryological Society Centenary Symposium, Glasgow, joined a guided tour to the Glasgow Botanic Gardens to see the vascular plants in the Kibble Palace and the Filmy Fern House and, of course, the many bryophytes growing in these greenhouses. Among the mosses was the beautiful *Hypopterygium atrotheca* Dix., which is hitherto only known from these Gardens. *H. atrotheca* is very abundant in the Kibble Palace, where it is found on soil, stones, and bases of trunks of tree ferns, often growing in large, dense groups of mostly medium sized plants. *H. atrotheca* was less abundant in the Tropical Fern House. Only a few plants were found in the Filmy Fern House, but among them were some large ones. Fruiting specimens were, unfortunately, not observed.

H. atrotheca was described by Dixon (1928), who examined fruiting material that was collected by Robert Grierson in the "Kibble Palace Fernery". Dixon reported that "the present species grows, and has been known for more than twelve years, on stems of large tree-ferns and on stones under their shade, where it has spread over a large area". It is most astounding that *H. atrotheca* has now grown and survived in the Gardens for more than 80 years!

H. atrotheca belongs to a small family of pleurocarpous mosses, the Hypopterygiaceae Mitt. They are characterized by having partly or entirely complanate stems and branches, whose complanate parts are set with two rows of asymmetrical, lateral leaves and a single, ventral row of smaller, symmetrical ones (amphigastria). The family contains 7 genera and 24 species. *Hypopterygium Brid.* is the largest genus with 10 species.

The plants of *H. atrotheca* are, like plants of other *Hypopterygium* species, very showy, mostly dendroid and less often pinnate or flabellate mosses. They are differentiated in a creeping rhizome, an ascending stipe, and a frond consisting of a branched rachis and its branches. The plants are variable in habit, the size of the plant, and the degree of ramification. The habit is highly affected by the orientation of the substratum towards the angle of the light.

It is evident that *H. atrotheca* was introduced in the Glasgow Botanic Gardens and originally came from elsewhere. The moss was almost certainly carried along with imported tree ferns. Most of the large tree ferns growing to date in the Kibble Palace originate from Australia, but the "true" origin of the original phorophyte of *H. atrotheca* is not known (cf. Dixon, 1928). It is of botanical interest to know with which *Hypopterygium* species in the wild *H. atrotheca* is most closely related.

Hypopterygium atrotheca: relationships within *Hypopterygium*

The genus *Hypopterygium* occurs in humid, tropical and subtropical regions in both the northern and southern hemisphere, (warm)-temperate regions of the southern hemisphere and eastern Asia, and along the western and north-eastern coast of the Pacific. The mosses are found most abundantly in humid forests, where they grow either terrestrially, on rocks, rotting logs, or epiphytically on tree trunks, branches and on tree ferns. The ecology of *H. atrotheca* in the greenhouses corresponds with that of wild representatives of *Hypopterygium*.

Because of its mostly palmate, less often (bi)pinnate, plants and its entirely tristichous (or nearly so) phyllotaxis, *H. atrotheca* shows most affinity with the *H. tenellum* complex, a group of five very similar and hence probably closely related species. These species occur in South and Central America including the Caribbean (*H. tamarisci* (Sw.) C. Müll.), Africa (*H. laricinum* (Hook.) Brid.), Indo-Malaysian and Sino-Japanese Asia (*H. tenellum* C. Müll.), Melanesia and Polynesia (*H. debile* Reichdt.), and Australia and New Zealand (*H. muelleri* Hampe). In the latter species two groups can be recognized within Australia. A northern group of monoecious, gemmiferous plants, whose amphigastrium costa reaches usually up to 2/3 of the length of the amphigastrium, predominates in Queensland and New South Wales. A southern group of dioecious, non-gemmiferous plants, whose amphigastrium costa exceeds 2/3 of the length of the amphigastrium, is most frequently found in Victoria, but also occurs in other regions of continental Australia (*H. muelleri* is very rare in Tasmania). Intermediates between these groups are frequently found. Plants of *H. muelleri* from New Zealand resembles most Australian plants of the northern group.

Delimitation of the species within the *H. tenellum* complex is problematic. Morphological differences between the species, which suggest reproductive isolation and support evidence for their status as separate species, are small. *H. tenellum, H. debile,* and *H. muelleri* show such minor differences, that they are possibly conspecific. Identification of material of species belonging to the *H. tenellum* complex without knowing its geographical origin is very difficult.

Unfortunately, the origin of *H. atrotheca* is unknown and hence it was very difficult to ascertain to which wild species of the *H. tenellum* complex *H. atrotheca* has most affinity. In addition, mosses that grow in glasshouses may show poorly developed features or be abnormal. The present study of the origin of *H. atrotheca* was also hampered by the fact that Dixon's type could not be found in his herbarium. It was not in the material of Hypopterygiaceae I had on loan from the British Museum (Natural History) (BM), London, England, and nor did I find it, when I visited this herbarium in 1994. Fortunately, an isotype was present in the material I had on loan from the herbarium of the "Naturhistorisches Museum Wien" (W), Vienna, Austria.

Hypopterygium atrotheca: origin and relationship with *H. muelleri*

H. atrotheca shows closest affinity with *H. muelleri* and it is very similar to plants of this species that come from southeastern Australia. The isotype of *H. atrotheca* is a non-gemmiferous, fruiting plant, which is up to 3.6 cm tall (fig. 1). Its branches are distant or closely set. In a few ramets distant branches predominate resulting in fronds with an open appearance. The costa reaches 2/3 - 3/4 of the length of the lateral leaves and mostly 1/3 - 2/3 of the length of the amphigastria, but is occasionally percurrent in the latter. The amphigastria are short-elliptic to ovate. The isotype is monoecious. Its gametoecia are either unisexual or bisexual, and lack paraphyses. There are up to 7 sporogones per frond. Dixon described the seta as being 1 mm long, which is almost certainly a mistake, and the colour of the theca as dark brownish olivaceous, becoming dark blackish brown when fully ripe. In the isotype, I observed a 7 - 9 mm long seta and an ochraceous theca.

The plants of *H. atrotheca* collected on August 5th 1996, are very similar to the isotype of *H. atrotheca,* especially those from the Filmy Fern House and the Kibble Palace; the plants from the Tropical Fern House are much smaller. Most plants are non-gemmiferous, but a senescing plant possessed gemmaphores. The costa of the lateral leaves and the amphigastria is somewhat longer in the material from the Filmy Fern House and the Kibble Palace and somewhat shorter in that from the Tropical Fern House than in the isotype. The material from the Filmy Fern House and the Tropical Fern House is sterile. The material from the Kibble Palace contains female plants. A non-fruiting specimen of *H. atrotheca* collected by E. Wallace in the Kibble Palace on July 6th 1963, is almost identical to the recently collected material from the Kibble Palace, but is monoecious. Most striking difference between the recently collected, fertile material of *H. atrotheca* and the older material was the presence of a few paraphyses of 5 to 7 cells long in the gametoecia of the former and the absence of such long paraphyses in the gametoecia of the latter. However, the length of the paraphyses in the recently collected material might be abnormal and was possibly induced by the unnatural conditions in the greenhouse. The paraphyses observed in *H. muelleri* and the older material of *H. atrotheca,* if present, are much shorter and hardly distinct from its gametoecial axillary hairs. *H. atrotheca* shows some resemblance with plants of *H. muelleri* of the southern Australian group, but is best considered to belong to the northern Australian group.

Evidence for an Australian origin of *H. atrotheca* was also provided by examination of mosses that grew intermingled with the type material of *H. atrotheca.* Dixon reported that Grierson collected also other mosses in the Kibble Palace Fernery. Among them was an introduced *Achrophyllum*-species, which, according to Dixon, agreed quite well with *Achrophyllum ("Pterygophyllum") dentatum* (Hook. f & Wils.) Vitt & Crosby, which is known from Australia, New Zealand, and southern South America. Dixon suggested that the *Achrophyllum* species might come from New Zealand or South America and he considered it most likely that *H. atrotheca* was imported together with this *Achrophyllum*-species. He remarked, however, that *H. atrotheca* certainly does not agree with any *Hypopterygium*-species from New Zealand.

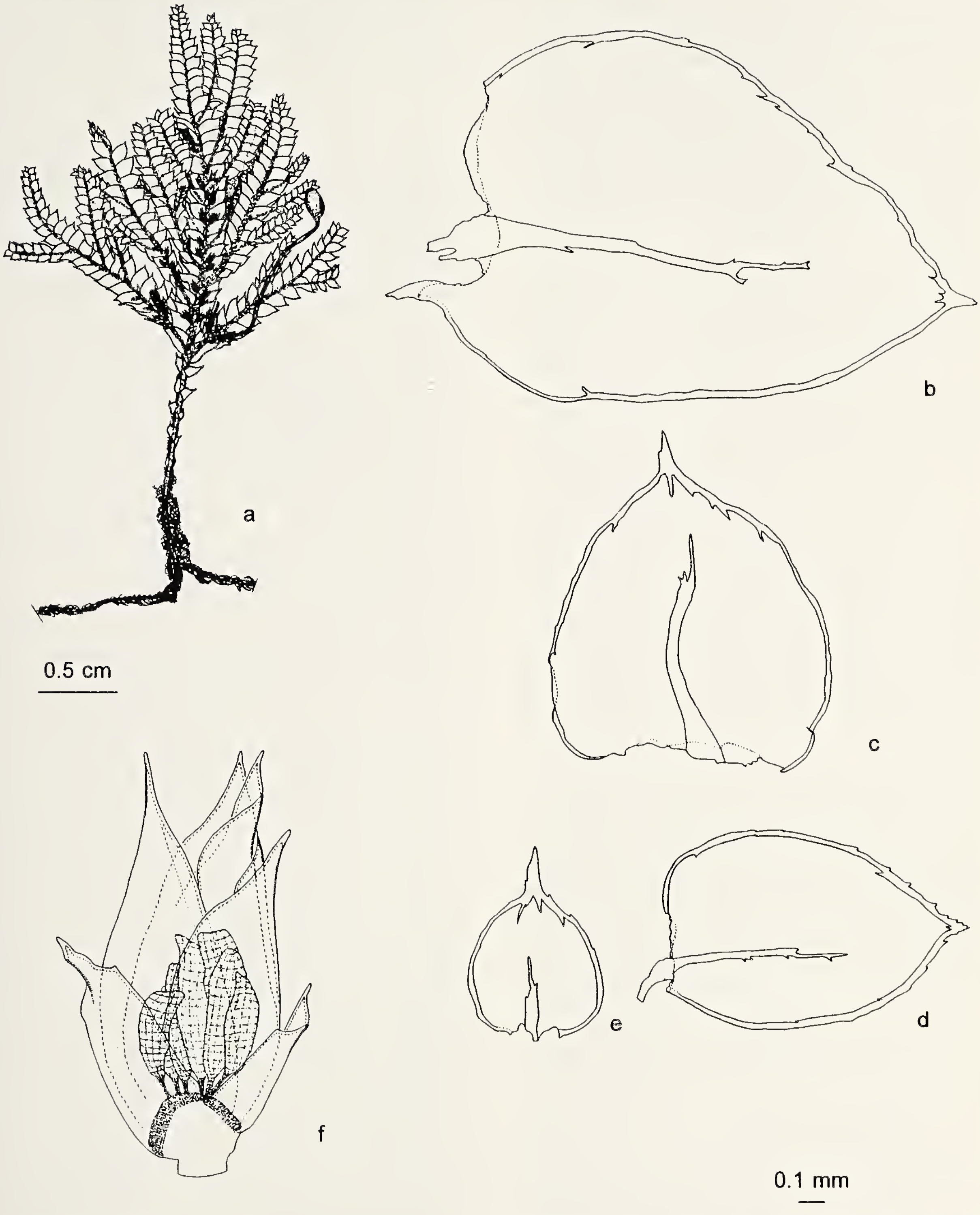
The isotype of *H. atrotheca* is intermingled with a small quantity of *A. dentatum.* If *H. atrotheca* was introduced together with *A. dentatum,* which is very likely, because they were also found growing intermingled on or near tree ferns in greenhouses of other botanic gardens (see below), then *H. tamarisci* may in all probability be discounted as the most closely related species of *H. atrotheca*, because *H. tamarisci* is very rare in southern South America. Thus, the occurrence of *A. dentatum* with the type material of *H. atrotheca* suggests an Australian-New Zealand origin, whereby the material of *A. dentatum* shows closest resemblance to Australian material of this species. Hence, in all probability *H. atrotheca* in the Glasgow Botanic Gardens came originally from Australia, presumably southeastern Australia, and is conspecific with *H. muelleri.*

GENERAL HISTORY

The introduction of *Hypopterygium species* is not unique for the Glasgow Botanic Gardens and has to be seen in the light of the horticultural history of ferns. In the nineteenth century ferns became increasingly popular in Europe, and many tree ferns were imported in the second half of the century, mostly from Australia and New Zealand (cf. Schneider, 1892). The tree ferns were mostly grown in tubs or greenhouses of private owners or botanic gardens, and less frequently outdoors. Epiphytic mosses associated with the tree ferns were frequently carried along and hence introduced.

For instance, the large and, in Australia and New Zealand, well-known moss *Cyathophorum bulbosum* (Hedw.) C. Müll another representative of the Hypopterygiaceae and known

Figure 1. *Hypopterygium atrotheca* Dix. from the Glasgow Botanic Gardens (*Grierson s.n.*). a. habitus; b, c. basal frond leaves; d, e. distal frond leaves (b, d, lateral leaves; c, e amphigastria); f. (male) gametoecium.



from Papua New Guinea, continental eastern Australia, Tasmania, and New Zealand, was collected a few times in greenhouses of the botanic gardens of Charlottenburg, Berlin, (*Graef s.n.*, JE), Munich (*s. coll. s.n.*, JE, 2 specimens), Germany, and Uppsala (*Lindberg s.n.*, S; *Nyman s.n.*, S), Sweden. All specimens collected from these places were found on the trunks of imported *Dicksonia*-tree ferns. The labels of the two collections made in Uppsala indicate that the tree fern comes from New Zealand. The label of one of the two collections made in Munich reports Australia as the origin of the tree fern. Although the origin of the other collections was uninterpretable or not given, they presumably also come from either Australia or New Zealand.

In a similar way *Hypopterygium* species were introduced to European places other than Glasgow. Since 1885, in several botanic gardens, populations of *Hypopterygium* have been found. Besides *H. atrotheca,* a few of the introduced *Hypopterygia* were described or treated as new species.

Hypopterygium immigrans: origin and relationships

In 1887 Greenwood Pim found a population of *H. immigrans* Lett in his cold fern-house at Easton Lodge, Monkstown, Co. Dublin, Ireland (Lett, 1904). I have seen only a single specimen that is presented as *H. immigrans*, which was collected at the type locality by an unknown collector (TDC). It is a small to medium sized, non-gemmiferous, non-fruiting plant, which, apart from the lack of sporogones, closely resembles Lett's (1904) illustrations of *H. immigrans.*

This specimen is a pinnate, flabellate, to weakly palmate plant, which is up to c. 1.9 cm tall. It is monoecious, having numerous unisexual and few bisexual gametoecia. Most unisexual gametoecia are male. The leaf costa reaches between 1/2 - 4/5 of the length of the leaf. The amphigastria are shortly elliptic to ovate. Their costa reaches at least c. 1/2 of the length of the amphigastrium, and is occasionally faintly excurrent. The frond leaves at the apex of several branches and rachides are absent, which indicates caducous top leaves, which is a common feature in the *H. tenellum* complex.

Lett's (1904) illustrations and the material collected in Pim's fern house show, that Pim's moss almost certainly belongs to the *H. tenellum* complex and shows closest affinity with *H. tenellum* and the northern Australian group of *H. muelleri.* Dixon (1928) remarked that according to Lett's description *H. immigrans* is "a much smaller plant, with more toothed leaves, shorter nerve, and different coloration", but his differences are not substantial. In fact, except for its caducous leaves and monoecy, the material presented as *H. immigrans* resemble small ramets in the type of *H. atrotheca* and the material from the Tropical Fern House in the Glasgow Botanic Gardens.

It was not possible to come with certainty to a more accurate identification of Pim's moss, because its origin is not known. Lett did not give the possible origin of either the moss or its phorophyte, when he suggested that the moss was probably carried along on the roots of a tree fern. However, since most tree ferns that were imported in Europe came from Australia and New Zealand, it is conceivable that Pim's tree ferns originated also from these areas. Supporting evidence for this hypothesis is provided by the fact that it is almost certain that the moss came from a temperate area, because it flourished for at least 17 years in Pim's cold greenhouse (cf. Lett, 1904). This may suggest that *H. immigrans* is conspecific with *H. muelleri.*

Hypopterygium balantii: origin

Presumably between 1893 and 1896, Baenitz distributed, in his exsiccata series *Herbarium europaeum,* specimens of *H. balantii* C. Müll. ex Baenitz, which were collected by P. Sydow between 1891 and 1893 in the "Flora" of the Botanic Garden of Charlottenburg (Berlin, Germany). It is not known with certainty whether this *Hypopterygium* was found growing on a tree fern, but most likely it was.

Between 1884 and 1890 Hugo Graef and other collectors collected material of almost certainly the same moss from in all probability the same trunk of a very old tree fern of *Dicksonia antarctica* Labill. *("Balantium antarcticum")* (cf. Amann, 1913; Warnstorf 1900, 1905). Although the tree fern was first recorded in the seed lists of the botanic garden by Eichler *et al.* in 1878 (the seed lists of 1877 are missing), I did not find such early collections of this moss in all the material that I examined for my forthcoming revision of the Hypopterygiaceae. No specimens were present that with certainty were collected from the tree fern after Sydow's material.

The origin of the phorophytical tree fern of the Charlottenburg mosses is not known. It was not given by, and probably unknown to, the collectors of these mosses. Paris (1896, 1905) suggested New Zealand as the possible origin of the material that was distributed by Baenitz. Warnstorf (1905) reported that his material probably came from Tasmania.

It can be safely assumed, however, that the *Dicksonia antarctica,* and hence the accompaning mosses, came from eastern continental Australia or Tasmania. Schneider (1892) reported that *D. antarctica* was produced in continental Australia, Tasmania, and New Zealand, but it is almost certain that New Zealand as possible origin can be discounted. Schneider, presumably following Hooker f. (1855), included the very closely related *D. fibrosa* Col. (cf. Cheeseman, 1925; Allan, 1961) from New Zealand in his concept of *D. antarctica,* but in the nineteenth century *D. antarctica* was commonly known to come from eastern Australia and Tasmania (e.g. Christ 1897, Hooker & Baker, 1883). In addition, Christ (1897) remarked that *D. antarctica,* from East Australia and Tasmania, was often grown in horticulture.

The *Hypopterygium* from Charlottenburg, like *H. atrotheca* from Glasgow, grew intermingled with *Achrophyllum* Vitt & Crosby. A few collections of the *Hypopterygium* made by Graef and Lucas contain a small quantity of this *Achrophyllum* species. In a posthumous publication, Müller (1902) described the *Achrophyllum* as a new species, *Hepaticina balantii, comb. inval.,* and a small quantity of the *Hypopterygium* was found in, and picked out of, a collection of *Hepaticina balantii* preserved in L. These mosses were collected by Graef in October, 1885, on an old trunk of *Dicksonia ("Balantium"),* presumably the same tree fern from which the other material of *Hypoptrygium* was found. The *Achrophyllum* species was apparently also found on a fern of *Todea barbara* (L.) Moore (Müller, 1902; Warnstorf, 1900, *"Hookeria balantii* C. Müll."), which is known from South Africa, Australia, Tasmania, and New Zealand (Allan, 1961; Field 1890). The fern concerned here was presumably shipped to Europe with the same lot of ferns as the tree fern of *D. antarctica* in Charlottenburg and hence has presumably the same origin, because *T. barbara* was, like *D. antarctica,* first recorded in the seed lists of the botanic garden by Eichler *et al.* in 1878.

In addition, a single collection of *H. balantii* made by Lucas in 1887 (W, *s.n,*) contains a small quantity of *C. bulbosum,* which provides further evidence that the *Hypopterygium* from Charlottenburg came from continental Australia, Tasmania, or New Zealand.

Hypopterygium bouvetii: origin

In 1897 G. Bouvet found a scrap of *Hypopterygium* on an old trunk of *D. antarctica* in a private greenhouse in Angers, Maine-et-Loire, France. Since, he had observed this moss growing on other old trunks of this tree fern-species in greenhouses of the botanical garden of Paris and the horticultural school of Versailles (Bouvet, 1898). As argued above, it is almost certain that these tree ferns and their accompaning mosses came from eastern continental Australia or Tasmania.

Bouvet (1898) identified the moss as *H. balantii* C. Müll. Although Bouvet's material from Angers is almost identical to small plants found among the material of *Hypopterygium* from Charlottenburg, Bescherelle (1898) described Bouvet's moss as the new species *H. bouvetii.*

Hypopterygium muelleri in Europe

The *Hypopterygia* from Charlottenburg and Maine-et-Loire closely resemble *H. muelleri.* It is beyond any doubt that these "European" mosses are conspecific with *H. muelleri,* because the distribution area of the latter species includes their possible areas of origin. Because *H. muelleri* is rare in Tasmania, it is unlikely that the mosses came from this area.

The *Hypopterygium* from Charlottenburg resembles in many aspects the material from the Glasgow Botanic Gardens. The plants from Charlottenburg are small to medium sized. They are usually flabellate to palmate and loosely or densely branched. Sometimes, the Charlottenburg-material is weakly etiolated and some collections contain a few simple ramets. The *Hypopterygium* from Charlottenburg is obviously monoecious, but female gametoecia may predominate in the collections. Several collections contain fruiting material. Gemmae were rarely found. The leaf costa reaches 1/2 - 3/4 of the length of the lateral leaves. The amphigastrium costa reaches 1/2 - 2/3 of the length of the amphigastrium and is occasionally excurrent. Despite the fact that the costa of the lateral leaves is shorter than usual in *H. muelleri* the *Hypopterygium* from Charlottenburg resembles most the northern Australian group of *H. muelleri.*

The type of *H. bouvetii* is a scanty, non-gemmiferous, sterile plant. Its short stems are simple or loosely branched. The leaf costa reaches c. 4/5 of the length of the leaf. In a few, basal amphigastria the costa reaches c. 2/3 of the length of the amphigastrium, but in most amphigastria the costa is distinctly percurrent. Presumably, *H. bouvetii* has closest resemblance with the southern Australian group of *H. muelleri.*

Warnstorf (in Loeske, 1903) identified a moss that was collected from an old trunk of the tree fern *Cyathea dealbata* (Forst. f.) Sw. in a greenhouse in Wengerode, Germany, as *H. balantii* C. Müll. If this moss was carried along with the tree fern, it may come from New Zealand, the Chatham Islands, or Lord Howe Island (cf. Cheeseman, 1925; Christensen, 1906), but most likely from New Zealand, where *C. dealbata* was collected for horticulture (Schneider, 1892). I have not seen the material that was reported by Loeske, but other material that was collected from the same locality by W Mönkemeijer and Sydow showed that the moss belongs to *H. muelleri.* Mönkemeijer's material, which was collected in 1901, was almost normally developed, whereas Sydow's plant, which was collected 5 years later, is very slender and etiolated.

Such slender and etiolated *Hypopterygia* were also collected by H.N. Dixon in 1908 from a *Dicksonia* in fernhouses of the botanic gardens in Amsterdam, The Netherlands, and, with A.B. Jackson, in Kew, London. According to Dixon's annotations the material from Amsterdam was found together with a *Cyathophorum.* I have not seen the latter moss, but it is almost certain that the *Hypopterygium* belongs to *H. muelleri.* The material from Kew grew in a temperate fern house and is poorly developed, but presumably also belongs to this species.

Dietzow collected a small and somewhat etiolated moss in the Botanic Garden of Königsberg (Kaliningrad), Russia, on *Todea rivularis* Sieb. (= *T. barbara*) in 1933. The fern came from Australia and arrived here in about 1903. There is little doubt that Dietzow's moss belongs to *H. muelleri.*

A few other *Hypopterygia* found in greenhouses of European botanic gardens presumably also belong to *H. muelleri.*

In 1903 Amann (1913) collected *H. balantii* C. Müll. ex Baenitz at the base of a trunk of *D. antarctica* in the "Palais d'hiver" of the "Jardin d'Acclimatation", Paris, France. Presumably, this moss had earlier been noticed by Bouvet (1898). Amann collected a good quantity of the moss, which is well developed and closely resembles small, terrestrial plants of *H. muelleri.* It is almost certain that this moss came originally from continental Australia or Tasmania.

In 1910 Gustav Schellenberg found *H. balantii* on tuff stones in the palm house of the botanical garden of Zurich, Switzerland. This male plant, which is occasionally gemmiferous at damaged stem parts, resembles the material of *H. atrotheca* from the Glasgow Botanic Gardens, but is more slender and partly somewhat etiolated. Its identity is not known with certainty, because its origin is completely unknown. This is also the case for a collection made by C. Cool in 1926 in the Botanic Garden of Leyden, The Netherlands, and a collection made by R.A.L. Potier de la Varde in the Palmarium of the Botanic Garden of Caen, France. Cool's moss is slender and partly gemmiferous and shows a strong resemblance with a few ramets in Schellenberg's collection that have closely set branches. Potier de la Varde's moss is etoliated and resembles the material from Wernigerode and Amsterdam.

The only locality known in Europe where *H. muelleri* grows outdoors is the Bussaco Forest in Portugal. The Bussaco Forest is an arboretum where since the nineteenth century exotic tree species have been introduced (V. Allorge, 1974). In this arboretum the moss is only found in the proximity of a cascade ("Cascata"), where it was found at first in 1929 by P. and V. Allorge (cf. Anonymous, 1931). The moss is still present in the Bussaco Forest and maintained here for more than 67 years. According to Cecília Sérgio (in litt., 1996) the population of *H. muelleri* is very large and even seems to be extending.

It is beyond any doubt that the moss is accidently introduced in Portugal. It is not known when *H. muelleri* arrived here (cf. V. Allorge, 1974), but presumably in or after 1887, when the cascade in the Bussaco Forest was constructed (V. Allorge, 1974). In 1931 P. Allorge sent material of *H. muelleri* to H.N. Dixon and wrote that he thought that the moss was introduced with exotic trees or with tree ferns, like in many greenhouses. According to V. Allorge the cascade is overshadowed by exotic trees, shrubs, and tree ferns. Seen in the light of the preceding, in all probability the moss was accidently transported with one of these tree ferns.

The Portuguese material shows a close resemblance with terrestrial plants of *H. tenellum* and *H. muelleri,* but shows its closest resemblance with terrestrial plants of the latter species from southern New South Wales and Victoria, Australia. The Portuguese material is intermediate between the two Australian forms of *H. muelleri.*

Other *Hypopterygium*-species

The *Hypopterygium* that has been grown on lava boulders in the hot houses of the Botanic Gardens of Utrecht, The Netherlands, since 1967 belongs to the *H. tenellum* complex, but its precise identity is not known. It shows no decisive morphological features and its origin is unknown.

In 1903, a few days after he collected *H. balantii* C. Müll. ex Baentiz on a trunk of *D. antarctica* (see above), Amann (1913) found a small quantity of this moss on *D. sellowiana* Hook in the hothouse of the "Jardin des Plantes" in Paris. It is almost certain that Amann did not collect the moss from the *D. sellowiana*, a tree fern known from southern Brazil, and its identity remains uncertain. Presumably, this moss belongs to *H. tamarisci*, although dispersal of the moss found on the *D. antarctica*, which belongs to *H. muelleri*, cannot be ruled out.

Not every introduced *Hypopterygium* belongs to the *H. tenellum* complex. Recently, E. Urmi found etiolated material of *H. vriesei* Bosch et Lac., known from Indo-malaysia, in the new Botanic Gardens of Zurich. This material is distinctly gemmiferous with numerous green, filiform gemmae that are situated in bundles in the axils of mainly the lateral leaves. Once, a specimen of *H. didictyon*, known from southeastern Australia, New Zealand, and southern South America, was found by Rev. Eloc on a tree fern of *D. antarctica* in a greenhouse in Neuilly near Paris. In nature, *H. didicyton* is much less often found on tree ferns than *H. muelleri*.

However, despite the latter findings, as a result of the importation of tree ferns in majority from Australia and New Zealand, where *H. muelleri* is the *Hypopterygium* species which is most frequently found growing on tree ferns, most of the *Hypopterygia* that were introduced in Europe between 1875 and 1930, including *H. atrotheca*, belong to *H. muelleri*.

NOMENCLATURE

In the course of this study, *Hypopterygium atrotheca* and *H. bouvetti* were considered to be conspecific with *H. muelleri* and are synonymized below. *H. immigrans* is proposed in the synonymy of *H. muelleri*.

The nomenclature of the names based on the *Hypopterygium* from Charlottenburg is problematic. Notes on these problems follow. It is evident that the *Hypopterygium* from Charlottenburg is conspecific with *H. muelleri*. Hence, the names attached to the *Hypopterygium* from Charlottenburg are synonymized with *H. muelleri* below.

Nomina nuda

Baenitz, in his exsiccata series, and Warnstorf (1900) treated *H. balantii* as a known species, which they ascribed to Müller. However, although Müller (1902) described the *Achrophyllum* species that was found in Charlottenburg, he did not publish on *H. balantii*. Neither Baenitz nor Warnstorf provided *H. balantii* with a description. Paris (1896, 1905) and Amann (1913) are the only authors who referred to Müller's name in Baenitz' exsiccata series, but they did not provide it with a description either.

It is not known whether Müller actually identified Sydow's material in Baenitz' exsiccata series. Baentiz did not indicate this material as belonging to a new species. Only specimens collected by Graef (and Graef & Lucas) on 13 November, 1885, and November, 1888, were presented as such.

Warnstorf (in Loeske, 1903) identified the material from Wernigerode as *H. balantii*. The name *H. balantii* was also used by Warnstorf in 1905, but neither Warnstorf (1905) nor Loeske (1903) provided *H. balantii* with a description. They neither referred to the only validly published taxon that was based on the Charlottenburg material: *H. rigidulum* Mitt. spp. *balantii* C. Müll. ex Kindb., a subspecies described by Kindberg (1901).

Wijk et al. (1964: 178), erroneously ascribed H. balantii C. Müll. to Loeske (1903: 333), and overlooked not only Müller's name in Baenitz' *Herbarium europaeum*, but also the other names published before 1903: Paris (1896: 699), and Warnstorf (1900: 66). Presumably they also overlooked the names given by Paris (1905) and Amann (1913).

Hypopterygium muelleri Hampe

Linnaea 28: 215 (1856). - *Pterobryon muelleri* (Hampe) Mitt., Trans. Roy. Soc. Victoria 19: 81 (1882). - Type: Australia, Victoria: *Austr. felix., In lapidibus ad ripam fluminis Buchan humidam ("Ad ripas flum. Buchan-river")*, March, 1854, *von Mueller s.n.* (BM holo, not found; MEL holo?, sub no. **40**; MEL iso, sub no.'s **40** and **111**).

Types of *H. muelleri* Hampe are absent from Hampe's herbarium kept in BM and were not found in other herbaria, except for two specimens in MEL. The potential holotype is provided with annotations by Hampe.

Hypopterygium bouvetii Besch., Bull. Soc. bot. Fr. 45: 490. 1898, *syn. nov.* - Type: France, Maine-et-Loire, Angers, sur les troncs de fougères arborescente dans les serres de M. Fargeton ["dans les serres des établissements horticoles, sur vieux stipes de *Balantium antarcticum*"], July 29, 1897, *Bouvet s.n.* (BM holo not found, PC!, mixed with *Racopilum* spec.).

Hypopterygium rigidulum Mitt. ssp. *balantii* C. Müll. ex Kindb., Hedwigia 40: 295. 1901, *syn. nov.* - Syntypes: Germany, Berlin, Charlottenburg, Botanic Garden of Berlin: palm house of the "Flora", "ad trancum *Balantii antarctii"*, Nov. 13, 1885, *Graef s.n.* (B destroyed; S lecto!, sub. no's 45 and 33 in hb. Kindberg; JE!); "ad truncum [putrid.?] *Balantii antarctii"*, Nov. 1888, *Graef s.n.* (B. destroyed; S!, sub. no's 45 and 33 in hb. Kindberg, JE!). - Lectotype selected here.

The specimen collected by Graef in 1888 is preserved in Möller's herbarium kept in S. Although there is no direct evidence that Kindberg saw this material, it is almost certain that he examined it for his revision (1901).

?Hypopterygium immigrans Lett, J. Bot., Lond. 42: 249, t. 463. 1904, *syn nov.* - Type: Ireland, Co. Dublin, Monkstown, Easton Lodge, ["On surface of earth in pots and rock-work in cold fernhouse"], 1887, *Pim s.n.* (not found).

The only specimen presented as *H. immigrans* that I have seen is presented as an isotype of *H. immigrans*, but there is no evidence for this. The specimen was collected by an unknown collector at the type locality of *H. immigrans* and it is preserved in TDC. It is not clear whether the specimen was collected in 1904 or had been collected earlier and was sent to Lett (or any other person) in that year. The specimen is a non-fruiting plant. Lett (1904), on the other hand, described fruiting material.

Hypopterygium atrotheca Dix., J. Bot., Lond. 66: 350. 1928, *syn. nov.* - Type: United Kingdom, Scotland, Glasgow, Botanical Gardens, Kibble Palace Fernery, tree ferns, "Origin unknown. But *soc. cum Pterygophyllo dentato"*, Febr. 1927, *Grierson s.n.* (BM holo not found, W!).

Hypopterygium balantii C. Müll. ex Baentiz, *Herbarium europaeum,* series number not known, collection no. **8088**, "Flora Marchica, 1891 - 93"; exsiccata presumably distributed between 1893 and in or before 1896, *nom. nud., syn. nov.* - *Hypopterygium banlatii* C. Müll. ex Amann, Revue. bryol. 40: 24. 1913, *typograph. err. pro* [*Hypopterygium balantii* C. Müll. ex Baenitz]. - Original material: Germany, Berlin, Charlottenburg, "Flora", *Sydow s.n.* (B destroyed; JE!, L!, S!, Z!).

Baenitz' *Herbarium europaeum* is an exsiccata series that contains mainly phanerogams, but also few cryptogams, including mosses. The label of the original material of *H. balantii* C. Müll. ex Baenitz was neither provided with a series number of the *Herbarium europaeum*, nor with date or year of distribution. These data could not be traced. A collection number was given for only a single specimen (in S). Purchasers of Baenitz' exsiccata and those interested in his *Herbarium europaeum* could order catalogues from Baenitz. Such catalogues were not found. They were presumably cut to labels for the obtained specimens. If so, the labels of specimens examined are identical with the text of Baenitz' catalogue that is of concern here. These labels are not provided with a description or diagnosis.

Hypopterygium balantii C. Müll. ex Bouvet, Bull. Soc. Étude. scient. Angers 27: 138. 1898, *nom. nud., syn. nov.;* presumably based on *Hypopterygium balantii* C. Müll. ex Baenitz.

Hypopterygium balantii C. Müll. ex Warnst., Verh. bot. Ver. Prov. Brandenb. 41: 66. 1900, *nom. nud.;* C. Müll. ex Warnst. in Loeske, Moosflora des Harzes: 333. 1903, *nom. nud.;* C. Müll. ex Warnst., Kryptogamenflora Mark Brandenburg: 659. 1905, *nom. nud.; syn. nov.* - Original material: Germany, Berlin, Charlottenburg, Botanic Garden of Berlin: palm garden "Flora", "ad truncum *Balantii antarctii"*, Nov. 13, 1885, *Graef s.n.* (B destroyed; S lecto!, sub. no's 45 and 33 in hb. Kindberg, JE!).

The original material is also a syntype of *H. rigidulum* Mitt. ssp. *balantii* C. Müll. ex Kindb.

Specimens of *Hypopterygium* examined

Angers: *Bouvet s.n.* (1897; PC). Amsterdam: *Dixon s.n.* (1908; BM). Bussaco: *P. & V. Allorge, Bryoth. Iber. 146* (1929; L, S, ZT; BM, *s.n.*), *Florin s.n.* (1930; S), *Rozeira s.n.* (1936; S), *Sérgio 2259* (1979, L). Caen: *Potier de la Varde s.n.* (1930; BM) Charlottenburg: *Graef s.n.* (22 Oct., 1884; Z), *s.n.* (12 Oct., 1885; JE), *s.n.* (13 Oct., 1885; S), *s.n.* (14 Oct., 1885; L, picked out a collection of *Hepaticina balantii*); *s.n.* (13 Nov. 1885; JE, JE *p.p.*, S *p.p.*, sub no.'s **45** and **33**), *s.n.* (1888; JE, S, sub no.'s **45** and **33**), *s.n.* (1889; JE), *s.n.* (without date; L); *Graef & Lucas s.n.* (13 Nov., 1885; S); *Hennings* (**44** + **36**) (without date; S, received in 1900); *Lucas s.n.* (1887; JE *p.p.*, W *p.p.*), *s.n.* (1888; GRO, JE), *s.n.* (1890, S, ZT), *s.n.* (without date; JE), *Sydow, "Flora Marchica, 1891 -93" s.n.* (1891 - 93; JE, L, S, Z). Glasgow: *Grierson s.n.* (1927; W), *Kruijer 96.08.01a-c* (1996, L), *Wallace s.n.* (1963, Z). Kew: *Jackson & Dixon s.n.* (1908; BM). Kaliningrad (Königsberg): *Dietzow s.n.* (1933; BM). Leyden: *Cool (3169)* (1926; GRO). Monktown: *s. coll., s.n.* (1887; TDC). Neuilly: *Eloc s.n.* (without date; S). Paris: *Amann s.n.* (1903; Z). Utrecht: *Kreulen s.n.* (1967; GRO), *Aptroot & Kruijer 90.03.01* (1990; L). Wernigerode: *Monkemeijer s.n.* (1901; JE), *Sydow s.n.* (1906; S). Zurich: *Schellenberg s.n.* (1910; S, Z), *Urmi s.n.* (1996; Z).

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STERILE SPECIES AND FERTILE HYBRIDS OF JAPANESE KNOTWEEDS ALONG THE RIVER KELVIN

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ABSTRACT

Fallopia japonica var. *japonica, F. sachalinensis* and their hybrid *F. x bohemica* occur along the River Kelvin in Glasgow. We describe their distribution along the river and in the surrounding area. All three taxa are gynodioecious, and in the Glasgow area we found only male sterile plants of *F. japonica* var. *japonica* and *F. sachalinensis*. Due to the absence of male fertile individuals of the parental taxa, we conclude that it is unlikely that the hybrid has arisen in situ.

INTRODUCTION

A wide range of plant species have been introduced (either deliberately or accidentally) to the British Isles, and have now become a significant component of our flora. While many of these introduced species occur in geographically restricted areas, others have become well established and widespread. Riparian habitats in particular have changed dramatically due to colonisation by some invasive alien weeds. One such species that has received considerable attention is the Japanese Knotweed - *Fallopia japonica* var. *japonica* (Houtt.) Ronse Decraene.

Fallopia japonica var. *japonica* was introduced to Britain from Japan in the early half of the 19th century. There is some debate as to the precise date, but the plants most probably came from a nursery in Leiden in ca. 1841 (Beerling *et al.*, 1994). Since its introduction it has spread to virtually all parts of the British Isles and its rapid spread coupled with the destructive capabilities of its rhizomes have led to it gaining notoriety as a troublesome weed.

A closely related species, the Giant Knotweed - *Fallopia sachalinensis* (F. Schmidt ex Maxim.) Ronse Decraene also occurs in Britain, and is again thought to be the result of a horticultural introduction in the 19th century, probably in the 1860's (Conolly, 1977).

Both *Fallopia japonica* var. *japonica* and *F. sachalinensis* are gynodioecious and can occur as either male-sterile (female) or hermaphrodite plants. In the hermaphrodite flowers, the stamens are (usually) longer than the perianth and the anthers are large, swollen and full of pollen. In the male sterile flowers the stamens are shorter than the perianth and the anthers are small, flat and empty. In Britain both female and hermaphrodite forms of *F. sachalinensis* have been recorded, but only male sterile plants of *F. japonica* var. *japonica* are known (Bailey, 1994). The implication of this is that *F. japonica* var. *japonica* is not capable of reproduction by seed in Britain, and that its spread is purely by vegetative propagation. Seed can be found on British plants of *F. japonica* var. *japonica*, but all seed examined so far is the result of hybridisation with closely related species such as *F. baldschuanica* (Regel) Holub, the Russian-vine, and *F. sachalinensis*. Although the majority of this seed appears to have *F. baldschuanica* as the pollen donor (Bailey, 1988), this hybrid very rarely becomes established in the wild. Only one such hybrid is known in Britain, in Haringey, Middlesex (Bailey, 1988). The hybrid between *F. japonica* var. *japonica* and *F. sachalinensis* - *F. x bohemica* (Chrtek & Chrková) J. Bailey is, however, more widespread (Bailey *et al.*, 1996). In Glasgow all three of these taxa (*F. japonica* var. *japonica, F. sachalinensis* and *F. x bohemica*) are known to occur along the banks of the River Kelvin and we describe here their distribution and reproductive biology along the watercourse.

DESCRIPTION OF TAXA

Fallopia japonica var. *japonica* grows annually to a height of about 3m and forms dense clumps with stout, erect and often red spotted stems arising from strong rhizomes. The leaf blades are 5-12 cm long, 5-8 cm wide, broadly ovate, cuspidate at the apex and truncate at the base, coarse in texture and glabrous (Beerling *et al*, 1994).

Fallopia sachalinensis, like *F.japonica* var. *japonica* is rhizomatous with stout, erect stems, but this species is somewhat larger and can grow up to 4m, and the stems tend to lack the red spotted appearance of *F. japonica* var. *japonica.* The basal leaves are much larger (28-40 cm x 18-24 cm) and ovate to oblong with a distinctive cordate base. The undersides of the leaves are scattered with long flexuous hairs (trichomes) (Bailey *et al.*, 1996).

The hybrid, *Fallopia x bohemica,* has an intermediate habit, growing from 2.5-4 m and its leaves are intermediate in both shape and size. The leaf tip is acuminate and the base is weakly to moderately cordate. The undersides of the leaves have numerous short hairs which are easily visible with a hand lens on the larger leaves (Bailey & Conolly, 1991). The stems show an intermediate level of spotting to the parental species. On morphological grounds, plants with red flecks on the stems, short hairs on the underside of the leaves, along with weakly cordate leaf bases are likely to be the hybrid. Some caution should be applied when using stem spotting as a character, as discolouration of *F. sachalinensis* stems (the taxon with which *F. x bohemica* is most likely to be confused) towards the end of the growing season can cause confusion.

Chromosome numbers

Chromosome counts for a number of individuals of all three taxa are given by Bailey & Stace (1992), and those from the British Isles are summarised in table 1. The difference in chromosome number of all three taxa is useful as it provides additional information to confirm identifications based on morphological characters.

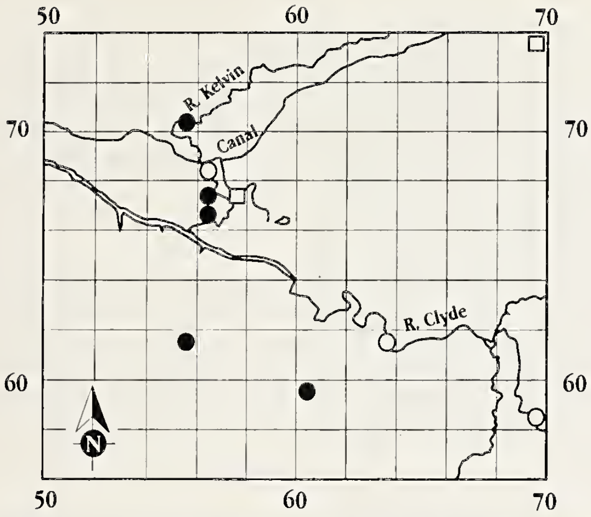

Figure 1.

Distribution map of *F. x bohemica* and *F. sachalinensis* in the Glasgow area and immediate surroundings.

Each square is a 4 square kilometre (= tetrad) block based on the Ordnance Survey National Grid. A sample of grid lines (50, 60, 70) is labelled for reference.

Topographical features include the Rivers Clyde and Kelvin and the Forth and Clyde Canal.

Black Circles = *Fallopia sachalinensis*
White Circles = *Fallopia x bohemica*
White Squares = both taxa

Three records from outlying areas are:
F. x bohemica NS/41.62 NS/54.78
F. sachalinensis NS/72.62

Table 1: Chromosome numbers of selected *Fallopia* species[1]

Fallopia japonica var. *japonica*	$2n = 88$	Octoploid
Fallopia sachalinensis	$2n = 44$	Tetraploid
Fallopia x bohemica[2]	$2n = 66$	Hexaploid

[1] Taken from Bailey & Stace (1992)

[2] A chromosome number of $2n = 44$ has also been recorded for *F. x bohemica*. This is from a cross between *F. sachalinensis* and *Fallopia japonica* var. *compacta* (which has $2n = 44$). Neither *F. japonica* var. *compacta*, or the hybrid between *Fallopia japonica* var. *compacta* and *F. sachlinensis* are known from the Glasgow area.

DISTRIBUTION AND ECOLOGY OF *FALLOPIA JAPONICA* VAR. *JAPONICA*, *F. SACHALINENSIS* AND *F. X BOHEMICA* ALONG THE RIVER KELVIN, GLASGOW

In the Glasgow area *Fallopia japonica* var. *japonica* has been recorded from the majority of the tetrads (Dickson, 1991) and is very likely present in all 90. It is found forming small or large stands in a variety of habitats such as parks, gardens, railway banks, waste ground and along riverbanks. Its spread is remarkable given the lack of seed production, and its current distribution reflects disturbance and transport by human activities, although along water courses, dispersal by floating rhizome fragments seems likely.

Fallopia japonica var. *japonica* is well represented along the River Kelvin from the Killermont Golf Course south to the confluence with the Clyde. In 1996, during a walk from the Kelvingrove Museum along the riverside to the Garscube Estate, we rarely walked a distance of 100 m without noting a stand of this species. Further north, near Summerston and Balmore, the open and grazed banks of the Kelvin provide a less suitable habitat. The Kelvin downstream of the Killermont Golf Course provides a mosaic of habitats, but all have been more or less disturbed in recent history, and the river water, although cleaner now than in previous times, is still enriched by agricultural drainage and treated sewage. *F. japonica* var. *japonica* can form particularly large stands on the alluvial influenced river banks and it can also extend up the banks above the reaches of even the highest floods.

The localities of *Fallopia japonica* var. *japonica* along the Kelvin can be rich in associated species, reflecting the complex mixing of habitats. Native plants of the shaded river edges include Wood Stitchwort (*Stellaria nemorum* L.), Comfreys (*Symphytum* spp.), Ramsons (*Allium ursinum* L.), Garlic Mustard (*Alliaria petiolata* (M. Bieb.) Cavara & Grande), Lesser Celandine (*Ranunculus ficaria* L.), Rough Meadow-grass (*Poa trivialis* L.), Giant Fescue (*Festuca gigantea* (L) Villars) and Bistort (*Polygonum bistorta* (L.) Samp.). Alien species can be particularly well represented and typically include Few-flowered Garlic (*Allium paradoxum* (M. Bieb.) Don), Pink Purslane (*Claytonia sibirica* L.), Dame's-Violet (*Hesperis matronalis* L.), Sweet Cicely (*Myrrhis odorata* (L.) Scop.), Daffodils (*Narcissus* spp.), Hybrid or Spanish Bluebells (*Hyacinthoides* spp.) and the other notorious 'toublesome weeds' Indian Balsam (*Impatiens glandulifera* Royle) and Giant Hogweed (*Heracleum mantegazzianum* Sommier & Levier). Additional diversity is provided by a range of often ephemeral colonisers of alluvial deposits, and the more ubiquitous aggressive species such as Nettle (*Urtica dioica* L.), Creeping Thistle (*Cirsium arvense* (L.) Scop.), Cleavers (*Galium aparine* L.), Common Couch (*Elymus repens* (L.) Desv. ex Nevski) and Ground Elder (*Aegopodium podagraria* L.).

Fallopia sachalinensis and the hybrid, in contrast to *F. japonica* var. *japonica,* are rare in the local Glasgow area. Their distributions are summarised in fig. 1. The localities of *F. sachalinensis* are associated with the landscaped gardens of former Policy Estates, where it was presumably first introduced, although the plants have usually spread to the adjacent water courses where they may form large stands. It occurs in similar situations to, and shares associates with, *F. japonica* var. *japonica,* and can out compete it on alluvial influenced sandy river banks. The hybrid is also associated with old estates, where it may well have been introduced from nursery stock, but it also appears to show some of the invasive characteristics of *F. japonica* var. *japonica* as at Eastfield Burn and South Johnstone where it grows in disturbed areas, well away from an obvious local source.

Along the Kelvin, *F. sachalinensis* occurs in three large but very localised stands. The furthest upstream is at the Garscube Estate (NS/551.702), where a dense stand approximately 20 m long is present on the south bank of the river. The second stand is situated some 3.5 km downstream on the north bank by the Queen Margaret Drive road bridge (NS/

57.67). This is the largest stand of *F. sachalinensis* on the river, and stretches from the Botanic Gardens footbridge at (NS/569.675) to the road bridge (NS/571.675). This stand continues downstream to the weir at NS/571.674, although here it is less dense being interspersed with other Knotweed taxa. The third stand is on the north bank of the river at the Kelvin Way road bridge at NS/569.663. *F. sachalinensis* grows here in a few small discrete clumps along with *F. japonica* var. *japonica*. At this site the abundance of *F. sachalinensis* has recently been much reduced due to erosion of the river bank and chemical spraying.

Fallopia x bohemica was first recorded on the River Kelvin in 1993, immediately upstream of the footbridge at NS/568.680. At this site there is a stand approximately 15 m long on a steep embankment on the west side of the river. During the course of this survey we identified two further sites, although one of these was only a small isolated clump on the west side of the river, downstream of the footbridge at NS/569.680. The most extensive stand of this hybrid, and perhaps the easiest place to view it, is by the Queen Margaret Drive road bridge. Here, on the south bank of the river there are three large patches of *F. x bohemica* growing between the footbridge and the road bridge (NS/570.675) along with large stands of *F. japonica* var. *japonica*. On the north bank of the river, immediately downstream of Queen Margaret Drive road bridge, the hybrid grows over a 100 m stretch of the river bank down to the weir (NS/571.674-5). *F. x bohemica* grows here with both *F. sachalinensis* and *F. japonica* var. *japonica* and the differences in morphology between the three taxa can clearly be seen.

Table 2: Locality, sex and chromosome numbers of *Fallopia* species from the River Kelvin (F = male sterile; FM = hermaphrodite)

Locality	Grid Reference	Sex	Chromosome number
F. x bohemica			
Botanic Gardens (west bank)	NS/568.680	F	2n = 66
Botanic Gardens (west bank)	NS/569.680	FM	2n = 66
Botanic Gardens (north bank)	NS/571.674-5	FM	2n = 66
Botanic Gardens (south bank)	NS/570.675	FM	2n = 66
F. sachalinensis			
Botanic Gardens (north bank)	NS/569-71.674-5	F	2n = 44
Kelvin Way (north bank)	NS/569.663	F	2n = 44
Garscube (south bank)	NS/551.702	F	2n = 44
***F. japonica* var. *japonica*[1]**			
Botanic Gardens (north bank)	NS/571.674	F	2n = 88
Botanic Gardens (south bank)	NS/570.675	F	2n = 88

[1] *F. japonica* var. *japonica* is abundant along the river, we include here only those localities from which we have cytological data.

Sex expression

All *Fallopia japonica* var. *japonica* and *F. sachalinensis* plants examined were male sterile. Both hermaphrodite and male sterile plants of *F. x bohemica* were found growing along the River Kelvin. The location of the plants examined and their sex is given in table 2.

Chromosome counts

Chromosome counts of all three taxa were made from mitotic root tip preparations as described by Bailey & Stace (1992), and the results are presented in table 2 and fig. 2. The chromosome numbers we obtained in all cases are in agreement with our identifications based on morphological characters and help confirm the identity of all three taxa.

DISCUSSION

The hybrid between *Fallopia japonica* and *F. sachalinensis* was first described in 1983 from the Czech Republic (Chrtek & Chrková, 1983) and Bailey & Conolly, (1985) subsequently suggested the presence of hybrids between *F. japonica* var *japonica* and *F. sachalinensis* in the British Isles. A recent survey by Bailey *et al.* (1996) indicates that *F. x bohemica* has been significantly under-recorded in the British Isles. In the Flora of Glasgow surveys, the hybrid was first recorded in 1991, and has presumably been over-looked or not distinguished from *F. sachalinensis* at locations such as Low Blantyre, Gartshore and along the Kelvin. A summary of the local records for *F. x bohemica* and *F. sachalinensis* is given in table 3.

Fallopia japonica var. *japonica* along with the other two taxa is now firmly established along the River Kelvin and as such they must be considered as important components of the local ecosystem. *F. japonica* var. *japonica* (and to a lesser extent the other two taxa) have received much bad press as a consequence of their vigorous growth and invasive abilities. A recent article describing these taxa in Britain was entitled "Japanese invader poised for the day of the triffids" (Nuttall, 1996). There have been conferences and local meetings concerned with the spread of Japanese Knotweeds (and other troublesome aliens) and there have been attempts at control, through chemical spraying, along the lower reaches of the Kelvin.

In recent years, however, some ecologists have called for a more long-term and dispassionate consideration of the ecological role of Knotweeds. Gilbert (1994) argues that *Fallopia japonica* var. *japonica* is "starting to play a valuable role in the ecology of urban areas". This view is supported by other authors and Dickson (1996) argued that Knotweeds and other alien plants should be seen as welcome additions to the British flora. *F. japonica* var. *japonica*, especially in its periodically disturbed riverside situations, is potentially an important climax vegetation. Winter flooding as well as providing additional nutrients, can remove dead stems and other debris, leaving open ground which can host a diverse array of vernal 'woodland' species; these are well adapted to early season growth before the *Fallopia* canopy shade becomes suppressive by mid-summer.

Fallopia japonica var. *japonica* is undoubtedly a very aggressive and damaging weed in many places, and often proves extremely difficult to control and eradicate, and is most unwelcome in parks and gardens. However, we consider

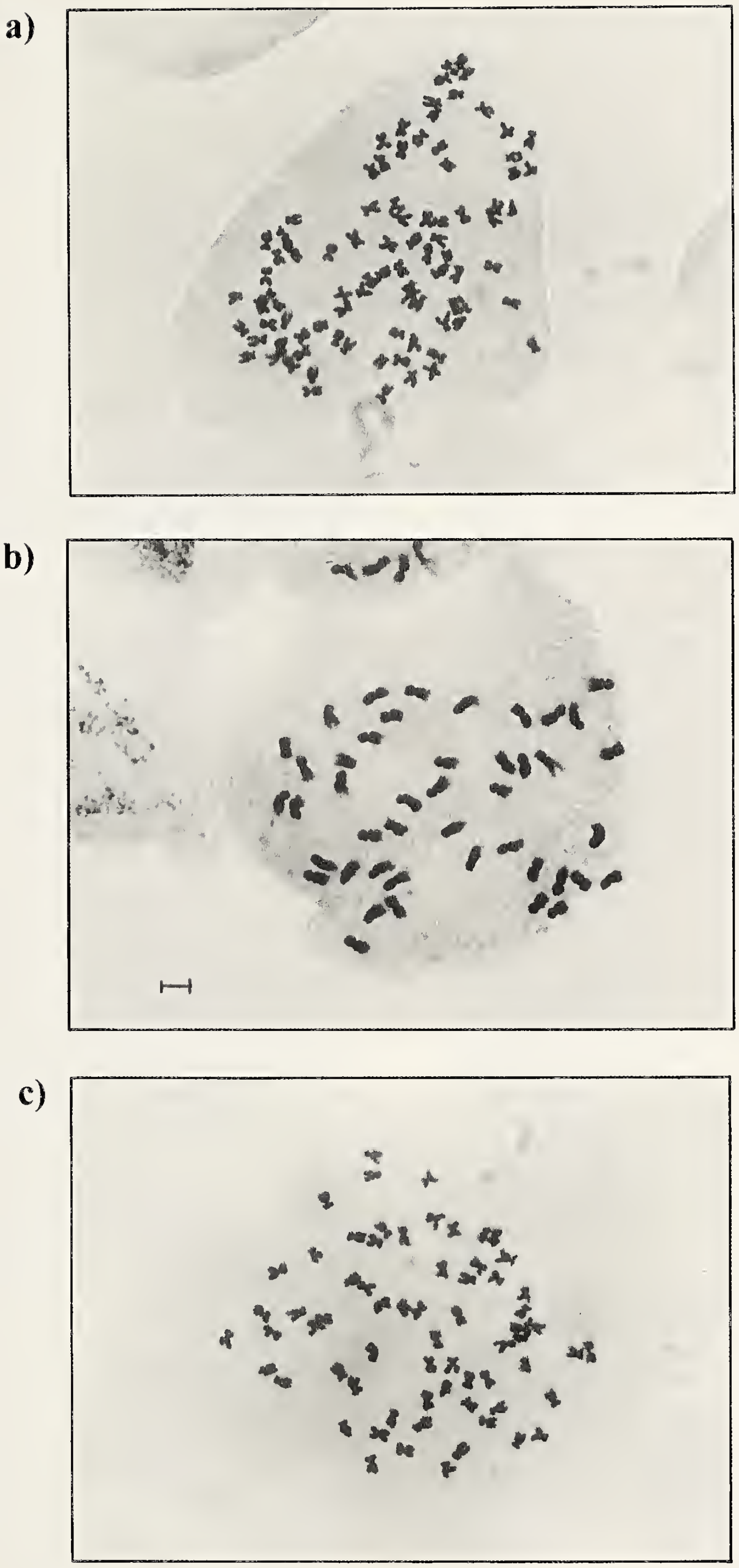

Figure 2 Mitotic chromosome preparations of a) *Fallopia japonica* var. *japonica,* b) *F. sachalinensis* and their hybrid, c) *F. x. bohemica* Scale bar = 3µm

that along certain urban riverbanks, the plant could be viewed as providing valuable ground cover and does not necessarily constitute a serious problem, and in fact may be beneficial to the local ecology. Rivers, such as the urban stretch of the Kelvin, have suffered much disturbance in the past, but they are naturally dynamic habitats, and the current development of the rich and varied flora along the Kelvin, both native and alien, should be welcomed.

Fallopia sachalinensis, F. japonica var. *japonica* and *F. x bohemica* form an unusual hybrid situation on the River

Table 3: Local Records of *Fallopia sachalinensis* and *F. x bohemica* **(F = male sterile; FM = hermaphrodite)**

Location	Grid Reference	VC	1st Recorder	Date	Sex
F. sachalinensis					
Pollok Park	NS/55.61	76	Dickson	1982	F
Castlemilk Glen	NS/60.59	77	Macpherson	1985	F
Botanic Gardens	NS/57.67	77	?	?	F
Kelvin Way	NS/56.66	77	?	?	F
Mill Bank	NS/72.62	77	Watson	1989	F
Gartshore Estate	NS/69.73	86	Dickson & GNHS	1987	F
Garscube Estate	NS/55.70	99	Watson	1988	F
F. x bohemica					
South Johnstone	NS/41.62	76	Watson	1994	FM
Eastfield Burn	NS/63.61	77	Macpherson	1993	F
Low Blantyre	NS/69.58	77	Macpherson & Lindsay	1991	F
Botanic Gardens	NS/56.68	77	Watson	1993	F
Botanic Gardens	NS/56.68	77	Hart, Hollingsworth & Watson	1996	FM
Botanic Gardens	NS/57.67	77	Hart, Hollingsworth	1996	FM
Dumbrock Loch	NS/54.78	86	Dickson	1994	FM
Gartshore Estate	NS/69.73	86	Hart, Hollingsworth & Watson	1996	F

Kelvin in Glasgow with the only male fertile taxon being the hybrid. Although we were not expecting to find any male fertile plants of *F. japonica* var. *japonica,* we were surprised, given the presence of *F. x bohemica,* that we found no male fertile plants of *F. sachalinensis.* It seems likely that on the River Kelvin *F. sachalinensis,* like *F. japonica* var. *japonica,* perpetuates by purely vegetative propagation. This raises the question as to how the *F. x bohemica* plants originated, as hybridisation between two effectively female populations of the parental species is impossible. We offer two possible explanations. Firstly that there either is, or once was, a male fertile *F. sachalinensis* in the area, unknown to us, and this served as the pollen donor to form the hybrid. A second possibility is that the hybrid has arisen elsewhere and its distribution along the River Kelvin with its parents is coincidental. We have checked all Glasgow records of *F. sachalinensis* and as yet have found no male fertile plants (table 3). We also examined all *F. x bohemica* populations in the Glasgow area, and the distribution of the sexes is shown in table 3.

Given the absence of male fertile *Fallopia sachalinensis* in the region, we have no evidence to suggest that *F. x bohemica* has arisen locally, and it seems likely that the hybrid has been introduced to the Glasgow area.

Futhermore, as we have found evidence for at least two clones of *F. x bohemica,* (one hermaphrodite and one male sterile), it is possible that it has been introduced on multiple occasions. The association of this taxon with the Botanic Gardens could well be far from coincidental, and it is quite possible that different clones have been introduced here. It should be borne in mind, however, that as the genetic basis of the difference between the male sterile and hermaphrodite forms is still unknown, we cannot rule out that the male sterile *F. x bohemica* plants are second generation hybrids that have arisen *in situ* from the hermaphrodite plants of *F. x bohemica.* Molecular studies using DNA fingerprinting are currently underway to try to determine the extent of the clonal diversity of all three taxa and to gain a deeper insight into their reproductive history.

ACKNOWLEDGEMENTS

Michelle Hart's work has been supported by a short term fellowship from the NERC Taxonomy Initiative at Glasgow University and the MAARA. The distribution map was drawn using Alan Morton's DMAP program. We are very grateful to the following people for providing information on the distribution of Japanese Knotweeds in the Glasgow area: E. Curtis, J.H. Dickson, E. Donaldson, J. Logan and P. Macpherson.

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GLASGOW NATURALIST Vol 23 Part 2 pp 23-24 (1997)

A REVIEW OF THE STATUS OF *DREPANEPTERYX PHALAENOIDES* (LINN.) IN SCOTLAND (NEUROPTERA; HEMEROIIDAE).

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INTRODUCTION

Drepanepteryx phalaenoides (Linn.) is an attractive lacewing which has a long history in Scotland. Its resemblance when at rest to a dead leaf is one of the best examples of camouflage exhibited by a British insect (see Plate 2). This, and its elusive behaviour, have ensured that it has been regarded as an insect of some note. The records show that it has been collected continuously at a number of Scottish localities for over 175 years.

HISTORICAL BACKGROUND

The appearance and apparent rarity of *D. phalaenoides* have meant that whenever it has been seen by naturalists the details have generally appeared in print. The earliest notice of its occurrence in the British Isles appears to be that of Curtis (1828) which mentions a specimen found near Lanark in June 1827 by a Mr H. Walker, thus giving the species native British status. This record has been requoted on a number of occasions (eg., King, 1901 & 1909; Morton, 1885 & 1910). Stephens (1829) included it in his list of British insects based on the cabinet of 'D. Walker', probably a mistranscription of 'H. Walker' and derived from Curtis. Stephens (1836) illustrates the species using a specimen from Raehills, Dumfriesshire which had been obtained from a Mr Little. It is most likely that this is the 'Rev. Mr William Little of Kirkpatrick-Juxta, Dumfriesshire' as acknowledged by the coleopterist Andrew Murray. Little had an extensive cabinet which had been seen and named by James Francis Stephens (1792-1852), thus giving an authority to the names so bestowed by such an expert, and providing an invaluable reference for entomologists remote from London (Murray, 1853).

The valley of the River Clyde near Lanark, embracing tributaries such as the Mouse Water and the Avon and Nethan gorges, was, and still is, popular with both sightseers and naturalists. *D. phalaenoides* was remarked upon following visits to both Cleghorn and Carluke by J.J.F.X. King, K.J. Morton and R. McLachlan during the year 1885 (Anon., 1887; Morton, 1885). Subsequently, Morton was to recall that he returned and found more up to the year 1893 (there is a specimen of his in the National Museums of Scotland from Cleghorn dated 5th October, 1891) when he added a new Scottish locality, Roslin, Midlothian, for the species (Morton, 1933).

The discovery of *D. phalaenoides* in Roslin Glen led to Morton collecting it on at least 26 occasions between 1933 and 1939 which are represented by 37 specimens in the National Museums of Scotland. Visits by others have produced it at Roslin also, as summarised in Table 1. Other sites in Perthshire (Beaumont, 1893), Banff (Thorburn, 1845), Dumfries (Stephens, 1836) and Roxburgh are included and also shown on the map (Fig.1).

Table 1. Scottish localities with summary of dates and numbers of specimens where known.

Locality	Date(s)	Nos.	Recorder	Source
Raehills, Dumfries.	18--?	1	Little	lit.
Cleghorn, Lanarkshire	1828	1	Walker	lit.
	1885-1893	5	King, Morton, *et al.*	lit.
Carluke, Lanarkshire	1885	[1]	King, *et al.*	lit.
	1892	1	Morton	lit.
	1996	1	Robertson	GM
Roslin, Midlothian	1933-1939	37	Morton	NMS
	1950	1	Fraser	lit.
	1985	1	Bland	NMS
	1995	1	Saville	NMS
Denholm, Roxburghshire	1972	1	Buckham	NMS
Pitlochry, Perthshire	1892	1	Beaumont	BOL
Forglen, Banffshire	<1845	[1]	Thorburn	lit.

BOL = Bolton Museum & Art Gallery; GM = Glasgow Museums; NMS = National Museums of Scotland; lit. = from published sources where specimens not known.

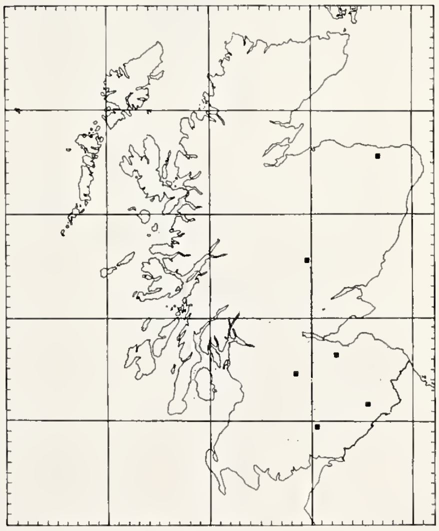

Figure 1. Distribution in Scotland based on specimens in museums and published records. Larger squares represent Ordnance Survey 100km grid system.

FINDING THE INSECT

Morton, as reported in Fraser (1951), lamented the difficulties in capturing this species, it having taken him on average up to four hours to find each individual, collected by beating beech, oak and hazel. This lacewing has also been beaten from sallows and alder (Morton, 1910).

One collecting method of particular value is light trapping (Plant, 1994) which can make the species appear common. Neville Birkett (*in litt.*, 14 September 1996) describes finding up to three specimens per night in a light trap in a wood in southern Cumbria. Otherwise hunting by net is difficult. It is possible that, like many of the snake flies (Rhaphidioptera), *D. phalaenoides* has a preference for tree tops, thus making it difficult or impossible to sweep or beat for them. Under certain circumstances steep sided wooded ravines bring the tops of trees more within reach. This might account for most of the Scottish records being from sites with this kind of topography.

According to available data (Fig. 2) the flight period in Scotland is from May to October with a peak in recorded activity in August. This would normally be regarded as typical of an univoltine insect (having one generation per year). It has been proposed that adults may overwinter from October onwards, only mating in the spring (Fraser, 1951). There is at present no evidence for this as adults have never been reported in hibernation. Standfuss (in Morton, 1910) believed that either eggs or larvae must be the overwintering stage. The matter remains unresolved with Aspück *et al.* (1980) giving it as 'Adult(?)' and even suggesting that there may be two generations (bivoltine). This issue requires further examination and the situation may differ over the geographical range of the species.

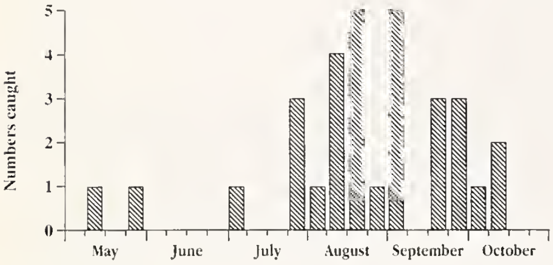

Figure 2. Dates of capture of Scottish records of *Drepanepteryx phalaenoides*.

IS IT MORE OR LESS COMMON?

Given the difficulty of finding this lacewing but in the knowledge that in certain places it can be found using appropriate searching techniques, we, like Morton (1933), are of the opinion that its former status as a rarity is only apparent. The current intensity of study of the Neuroptera in Britain, because of the well organised national recording scheme, is revealing *D. phalaenoides* as being local but widespread (Plant, 1994). Neuroptera were not dealt with in the insect Red Data Book (Shirt, 1987), but Kirby (1991) describes its status as 'local'.

At well known sites such as those in the Clyde Valley, Lanarkshire, and Roslin, Midlothian, this species has been shown to have been continuously resident for many years. It seems likely that field work at other promising places in Scotland would reveal a much wider distribution.

ACKNOWLEDGEMENTS

Bob Saville and David Robertson generously made available their specimens and Val Muirhead her excellent photographs of live examples from Roslin Glen. Steve Garland kindly provided the data from the Beaumont specimen from Pitlochry in the Bolton Museum collection. Invaluable records were obtained from SIRI (the Scottish Insect Records Index) and BRC (the Biological Records Centre, Huntingdon). Rose Whittington provided useful assistance with drawing the map (Fig 1.)

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SCOTTISH INSECT RECORDS FOR 1995

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The year 1995 was interesting for the period of unusually hot and dry weather in the summer (the lack of rainfall continued in the west of Scotland through the winter and well into 1996). Glasgow experienced more sunshine in June than in the previous 114 years' records for that month. Butterflies provided records of interest with the appearance of the Camberwell Beauty (*Nymphalis antiopa* (L.)) fairly frequently following a period of steady easterly winds during late July and August. Probably arriving in the company of the Camberwell Beauty was the spectacular Clifden Nonpareil moth (*Catocala fraxini* (L.)) which was seen in Scotland from Orkney southwards. This moth can also migrate from southern Europe via France in certain years rather than from Scandinavia. Purple Hairstreaks (*Quercusia quercus* (L.)) built up their populations to high levels and became more evident at a number of sites. Normally these butterflies are difficult to see as they tend to fly around the tops of Oak trees.

As with the previous two of these annual compilations there are some interesting ground beetle (Carabidae) records from surveys that have been carried out by staff and students of the Scottish Agricultural College, Auchencruive, Ayrshire. Their work has been on farmland where the disturbed ground provides favourable conditions for these beetles, many of which are currently regarded as rare. This indicates that farms can provide opportunities for certain insects not normally available in more 'natural' areas such as nature reserves. Preserving the full diversity of flora and fauna requires us to consider the conservation value of the whole environment, not just fenced-off protected areas. This issue was aired briefly in the *New Scientist* (anon, 1996) and will no doubt continue to be discussed at more length in the specialised conservation and scientific literature.

In the following list, specific names and reference numbers of the Lepidoptera are as in Bradley & Fletcher (1979) and as these entries are numbered, family names have been omitted. Other insects are given as in Kloet & Hincks (1964, 1976, 1977, 1978).

ODONATA

CALOPTERYGIDAE

Calopteryx virgo (L.), Beautiful Demoiselle. Grasspoint, Mull (NM745301), V.C.103, 21/6-1/7/95, AAJ.

LIBELLULIDAE

Orthetrum coerulescens (Fabr.), Keeled Skimmer. Croig Point, Mull (NH385549), V.C.103, 21/6-1/7/95, AAJ.

Libellula quadrimaculata L., Four-spotted Libellula. Old Glen Road, Mull (NH665313) and Croggan, Mull (NH718263), V.C.103, 21/6-1/7/95, AAJ.

NEUROPTERA

CHRYSOPIDAE

Chrysopa perla (L.). Upper Laird, Lewis, one male in outhouse (NB5536), V.C.110, 8/10/95, ME (det. SM). There are no previous records for Lewis for any member of this family, nor any for this species north of Glasgow, according to Plant (1994).

HEMIPTERA HETEROPTERA

LYGAEIDAE

Eremecoris abietis (L.). Nairn Bar, Nairn, under crowberry (NH9159), V.C.96, 20/7/95, SM. Due to taxonomic changes this species is now part of the British list (Judd, 1996) but does not appear in Kloet & Hincks (1964).

MIRIDAE

Trigonotylus psammaecolor Reuter. Nairn Bar, Nairn, on marram on fore dunes (NH9159), V.C.96, 20/7/95, SM.

CIMICIDAE

Cimex lectularius L., Bedbug. Perth, in house, (NO0923), V.C.88, 24/10/95, MJS; Cowglen & Invermulloch, Glasgow, V.C.77, five occurrences during 1995, JL. The incidence of bedbugs has fallen dramatically in urban areas in Britain because of extensive rehousing projects in the 1960s. This makes it an unfamiliar insect as shown by only five reports to the Environmental Health Department of Glasgow District Council during the year.

C. pipistrelli Jenyns, Batbug. Kilmacolm, Renfrewshire, V.C.76, late Autumn 1995, DM. This bug is either rare or under-recorded but on this occasion had been found in some numbers in a bedroom of a house after bats had spent the summer roosting in the roof space above. The similarity of this insect to the human Bedbug was such that the householder contacted the Environmental Services of Inverclyde District Council who passed it on to bat experts at Scottish Natural Heritage. Another record of this species which escaped published notice at the time was from a roost of Daubenton's bats near Lochearnhead, Perthshire (NN636243), V.C.88, 5/8/93, JH.

LEPIDOPTERA

61 *Stigmella serella* Stainton. Lomond Hills, Fife, mines in *Potentilla erecta* (NO2306), V.C.85, 28/9/95, KB.

72 *S. myrtillella* Stainton. Lomond Hills, Fife, mines in Bilberry (NO2306), V.C.85, 28/9/95, KB.

75 *S. floslactella* (Haworth). Moreland Meadow, Fife, mines in Hazel (NT0496), V.C.85, 6/8/95, KB.

89 *S. basiguttella* (Heinemann). Bemersyde Hill, Berwickshire, mines in Oak (NT5934), V.C.81, 26/9/95, KB.

154 *Heliozela sericiella* (Haworth). Lindores Loch, Fife, mines in Oak (NO2715), V.C.85, 28/9/95; Hermitage o' Braid, Edinburgh, Midlothian, mines in Oak (NT2570), V.C.83, 3/12/95, KB.

260 *Leucoptera malifoliella* (Costa), Pear Leaf Blister Moth. Linn of Tummel falls, Perthshire, mines in apple (NN9059), V.C.88, 6/10/95, KB.

292 *Caloptilia leucapennella* (Stephens). Mailerwood Oakwood, Perthshire (NN7518), V.C.88, 5/8/95; Campsie Hill, Perthshire (NO1333), V.C.89, 31/8/95, Laggan Wood, Comrie, Perthshire (NN7623), V.C.88, 16/9/95, KB.

351 *Phyllonorycter lautella* (Zeller). Laggan Wood, Comrie, Perthshire, blisters on Oak (NN7623), V.C.88, 16/9/95, KB.

356 *P. tristrigella* (Haworth). Caribber Glen, West Lothian, blisters on Elm (NS9675), V.C.84, 23.9.95, KB.

359 *P. nicellii* (Stainton). Moreland Meadow, Fife, mines in Hazel (NT0496), V.C.85, 6/8/95, KB.

390 *Eutromula diana* (Hübner). Affric Forest, Easterness, (NH2828 & NH3028), V.C.96, 16/7/95, KB.

524 *Coleophora lithargyrinella* Zeller. Kincraig Point, Fife, single larval case (NT4699), V.C.85, 12/9/95, KB.

580 *C. sylvaticella* Wood. Dura Den, Fife, single larval case (NO4115), V.C.85, 10/6/95, KB.

593 *Elachista regificella* Sircom. Bemersyde Hill, Berwickshire, mines in *Luzula* (NT5934), V.C.81, 26/9/95, KB.

616 *E. bedellella* (Sircom). Linkim Shore, Berwickshire, mines in *Helictotrichon* (reared), (NT9265), V.C.81, 15/6/95, KB.

635 *Schiffermuelleria subaquilea* (Stainton). Lomond Hills, Fife, (NO2205), V.C.85, 10/6/95; Craig Mellon, Angus (NO2676), V.C.90, 9/7/95, KB.

636 *S. similella* (Hübner). Glendoll Lodge, Angus (NO2776), V.C.90, 9/7/95, KB.

781 *Bryotropha mundella* (Douglas). Aberlady, East Lothian (NT4682), V.C.82, 3/6/95, KB.

840 *Reuttia subocellea* (Stephens). Linkim Shore, Berwickshire, larval cases on *Thymus* (reared), (NT9265), V.C.81, 22/8/95, KB.

1014 *Isotrias rectifasciana* (Haworth). Linkim Shore, Berwickshire, (NT9265), V.C.81, 15/6/95, KB.

1029 *Eana osseana* (Scopoli). Cleish Hills, Fife (NT0996), V.C.85, 6/8/95, KB.

1040 *Acleris caledoniana* (Stephens). Dow Loch, Cleish Hills, Fife (NT0996), V.C.85, 6/8/95, KB.

1068 *Olethreutes rivulana* (Scopoli). Little Ballo, Angus (NO2734), V.C.90, 17/7/95, KB.

1096 *Apotomis sauciana grevillana* (Curtis). Lomond Hills, Fife, larvae on Bilberry (reared) (NO2205), V.C.85, 10/6/95, KB.

1124 *Ancylis tineana* (Hübner). Struan Wood, Perthshire, larvae on Birch (reared) (NN7965), V.C.88, 4/9/95, KB.

1290 *Chilo phragmitella* (Hübner). Adderstonelee Moss, Roxburghshire (NT5311), V.C.80, 22/6/95, KB.

1367 *Pyrausta cingulata* (L.). Williamshope, Selkirkshire, (NT4133), V.C.79, 25/6/95, KB.

1405 *Pleuroptya ruralis* (Scopoli), Mother of Pearl. Craigend Hill, Midlothian (NT4446), V.C.83, 3/8/95, KB.

1555 *Callophrys rubi* (L.), Green Hairstreak. Croggan, Mull (NH718263), V.C.103, 21/6-1/7/95, AAJ; Blackhill Plantation, Helensburgh,(NS300838), V.C.99, 23/5/95, AD; Killantringan, Ballantrae, Ayrshire (NX097791), V.C.75, 1/5/95, JPB; near Loch Ordie, Perthshire (NO0254485), V.C.89, 7/5/95, PS.

1557 *Quercusia quercus* (L.), Purple Hairstreak. Firkin, Tarbert, Loch Lomond, (NN335011), V.C.99, 5/8/95, CJL; Buchan Burn, Glen Trool, Kirkcudbrightshire (NX417803), V.C.73, 25/7/95, JPB; Auchentorlie Wood, Dumbarton (NS432747), V.C.99, 2/8/95, JM; Carstrammon Wood, Kirkcudbrightshire (NX591596), V.C.73, 26/7/95, NR; Torr, Kirkcudbrightshire (NX814523), V.C.73, 31/7/95, NR; Garple Glen, Balmaclellan, Kirkcudbrightshire (NX645794), V.C.73, 4/8/95, NR; Southwick, Kirkcudbrightshire (NX914561), V.C.73, 9/76/95, RM&BM.

1574 *Polyommatus icarus* (Rottemburg), Common Blue. Ailsa Craig (NX0299), V.C.75, 30/6/95 and 5/7/95, BZ.

1596 *Nymphalis antiopa* (L.), Camberwell Beauty. Tighnabruich, Argyll, apparently feeding on sap run from sawn off stump of oak tree cut down earlier in year (NS9772), V.C.98, 28-29/7/95, JT; Durris, nr Banchory, Kincardineshire (NO798962), V.C.91, 1/8/95, PRM; Cults, Aberdeenshire, 2 or 3 individuals seen over 2 days (NJ8802), V.C.92, 1-2/8/95, MG; Culzean Country Park, Ayrshire, 1 seen on two days feeding on over-ripe peaches in peach house (NS2309), V.C.75, 3-4/8/95, GR.

1597 *Inachis io* (L.), Peacock. Barrhead, Renfrewshire, (NS5259), V.C.76, 12/4/95, DS; Sandford, Strathaven, Lanarkshire (NS716434), V.C.77, 7/5/95, DT; Bankend Farm, Lanarkshire (NS6436), V.C.77, 4/8-17/9/95, GS; Vogrie Park, Midlothian, (NT386635), V.C.83, 4/5/95, NMcK; St Andrews, Fife (NO5016), V.C.85, 16/9/95, RW.

1600 *Boloria selene* (Denis & Schiffermüller), Small Pearl-bordered Fritillary. Cathkin Braes, Glasgow, (NS6158), V.C.77, 24-26/6/95, CRS.

1601 *Boloria euphrosyne* (L.), Pearl-bordered Fritillary. Grasspoint, Mull (NH745301); Old Glen Road, Mull (NH665313); Croig Point, Mull (NH385549), V.C.103, 25/6-1/7/95, AAJ; Torlum Hill, Crieff, Perthshire, (NN832188), V.C.88, 10/6/95, JPB; near Alltdourie Farm, Aberdeenshire (NO158934), V.C.92, 17/6/95, PS.

1607 *Argynnis aglaja* (L.), Dark Green Fritillary. Grasspoint, Mull, (NM745301) and Croig Point, Mull (NH385549), V.C. 103, 21/6-1/7/95, AAJ.

1610 *Eurodryas aurinia* (Rottemburg), Marsh Fritillary. Birkhill, Clackmannanshire (NS9493), V.C.87, 13/7/95, DS. Although a colony of the Marsh Fritillary was thought to exist at this site and it had become widely reported as such, it has since been critically examined and does not provide suitable habitat for this species. The record may have been based on a misidentification and should be regarded as doubtful.

1617 *Erebia epiphron* (Knoch), Mountain Ringlet. Lochaber, an early date brought about by high temperatures of up to 30°C. 25/6/95, Bowles (1995); Glendoll Lodge, Angus (NO2777), V.C.90, 9/7/95, KB.

1621 *Hipparchia semele* (L.), The Grayling. New Craighall, Midlothian (NT3271), V.C.83, 25/7/95, KB; Bothwellpark Industrial Estate, Lanarkshire (NS703597), V.C.77, 16/9/95, WL.

1881 *Perizoma taeniatum* (Stephens), Barred Carpet. Mailermore oakwood, Perthshire (NN7518), V.C.88, 5/8/95, KB.

1972 *Agrius convolvuli* L., Convolvulus Hawk Moth. Cottown, Glencarse, Perthshire, found dead in garden (NO205211), V.C.89, 10/11/95, MJS; Bearsden, Glasgow, V.C.77, 11/9/95, MR.

1984 *Macroglossum stellatarum* L., Hummingbird Hawk Moth. Bardowie, Stirlingshire, feeding on Geranium flowers inside conservatory, V.C. 86, 3/7/95, JM.

2091 *Agrotis ipsilon* (Hufnagel), Dark Swordgrass. Loch Rannoch, seen in some numbers while snow still on hilltops nearby, 8/4/95, AS.

2214 *Cucullia chamomillae* (Denis & Schiffermüller), Chamomile Shark. Bush House, Midlothian (NT2462), V.C.83, 19/5/95, KB.

2320 *Hyppa rectilinea* (Esper), The Saxon. Acharn, Glen Doll, Angus, in light trap (NO1322), V.C.90, 10-11/7/95, KB.

2451 *Catocala fraxini* (L.), Clifden Nonpareil. Orkney, V.C.111, 9/9/95; Shetland, V.C.112, 10/9/95; Old Meldrum, Aberdeenshire, V.C.92, 9/9/95; Ordiquihill, Banffshire, V.C.94, 10/9/95, all records reproduced from Waring (1995); Falkirk, Stirlingshire, V.C.86, 1995 (no specific date available) JN.

COLEOPTERA

CARABIDAE

Carabus nitens L. Auchtertyre farm, near Crianlarich, pitfall traps in grassland (NN3530), V.C.88, 2/5-7/6/95, 7/6-30/6/95, 30/6-26/7/95, 24/8-5/10/95; (NN3633), 7/6-30/6/95, 26/7-24/8/95; Lochdochart farm, near Crianlarich, in grassland and heather moorland (NN3826), V.C.88, 2/5-7/6/95, 7/6-30/6/95,30/6-26/7/95, 26/7-24/8/95, 24/8-5/10/95, IR & DM.

Elaphrus lapponicus Gyllenhal. Auchtertyre farm, near Crianlarich, pitfalls in grassland (NN3632), V.C.88, 30/6-26/7/95; (NN3733), V.C.88, 2/5-7/6/95, 7/6-30/6/95, 30/6-26/7/95, 26/7-24/8/95, IR & DM.

E. uliginosus Fabr. Auchtertyre farm, near Crianlarich, pitfalls in grassland (NN3530), V.C.88, 2/5-7/6/95, 7/6-30/6/95; Lochdochart farm, near Crianlarich, in grassland (NN3825), 2/5-7/6/95, 7/6-30/6/95, 26/7-24/8/95, IR & DM.

Broscus cephalotes (L.). Dalmeny Park, Dalmeny, West Lothian, under log on high strand line (NT1777), V.C.84, 14/10/95, AR.

Miscodera arctica (Paykull). Abercairny farm, near Crieff, pitfalls in heather moorland (NN9295), V.C.88, 3/5-30/5/95, 30/5-27/6/95, 27/6-24/7/95, IR & DM.

Patrobus septentrionis (Dejean). Auchtertyre farm, near Crianlarich, pitfalls in grassland (NN3733), V.C.88, 30/6-26/7/95, IR & DM.

Aepus marinus (Strüm). Bo'ness, West Lothian, three examples under buried rock in mud on foreshore (NS9881), V.C.84, 18/11/95, AR.

Trechus micros (Herbst). Auchtertyre farm, near Crianlarich, pitfalls in grassland and mature conifer woodland, (NN3528), V.C.88, 2/5-7/6/95, 7/6-30/6/95, 30/6-26/7/95, 26/7-24/8/95, 24/8-5/10/95; Carsehead farm, near Crieff, in grassland (NN9422), V.C.88, 27/6-24/7/95, 28/8-9/10/95; Fornought farm, near Crieff, in grassland (NN9424), 3/5-30/5/95, 30/5-27/6/95; Carsehead farm, near Crieff, in arable field (NN9522), 3/5-30/5/95, 24/7-28/8/95, 28/8-9/10/95 Carsehead farm, near Crieff, in set aside (NN9523), 3/5-30/5/95, IR & DM.

Bembidion pallidipenne (Illiger). Loch Leven, Kinross, adults active on narrow strip of sandy shore (NO132036), V.C.85, 21/6/95, MS.

B. laterale (Samouelle). John Muir Country Park, East Lothian, adults active on sand near edge of tidal burn (NT641789), V.C.82, 22/6/95, MS.

B. minimum (Fabr.). John Muir Country park, East Lothian, under stones on fairly dry saltings mud and under high tide strand ((NT633798), V.C.82, 12/4/95, MS.

B. obtusum Serville. Fornought farm, near Crieff, pitfalls in grassland (NN9422), 3/5-30/5/95, 30/5-27/6/95, 27/6-24/7/95, 24/7-28/8/95, 28/8-9/10/95; Newbigging farm, near Crieff, in grassland (NN9423), 3/5-30/5/95, 30/5-27/6/95, 24/7-28/8/95; in grassland at Carsehead farm, near Crieff (NN9424), 30/5-27/6/95; Carsehead farm, near Crieff, in arable field (NN9522), 30/5-27/6/95, 24/7-28/8/95; Carsehead farm, near Crieff, in set aside (NN9523), 3/5-30/5/95, all in V.C.88, IR & DM.

Stomis pumicatus (Panzer). Abercairny farm, near Crieff, pitfalls in heather moorland and gorse at edge of heather moorland (NN9225), 30/5-27/6/95, 24/7-28/8/95 Fornought farm, near Crieff, in gorse within grazing pasture (NN9324), 24/7-28/8/95; Carsehead farm, near Crieff, in grassland (NN9422), 3/5-30/5/95, 27/6-24/7/95, 24/7-28/8/95; Newbigging farm, near Crieff, in grassland (NN9423), 27/6-24/7/95; Fornought farm, near Crieff, in arable field (NN9424), 3/5-30/5/95; Carsehead farm, near Crieff, in arable field (NN9522), 3/5-30/5/95, 30/5-27/6/95, 27/6-24/7/95, 24/7-28/8/95; Carsehead farm, near Crieff, in arable field and set aside (NN9523), 30/5-27/6/95, 27/6-24/7/95, 24/7-28/8/95, 28/8-9/10/95; Newbigging farm, near Crieff, in arable field (NN9524), 24/7-28/8/95, all in V.C.88, IR & DM.

Pterostichus aethiops (Panzer). Auchtertyre farm, near Crianlarich, pitfalls in grassland (NN3733), V.C.88, 7/6-30/6/95, 30/6-26/7/95, 26/7-24/8/95, IR & DM.

P. cristatus (Dufour). Carsehead farm, near Crieff, pitfalls in set aside (NN9523), V.C.88, 30/5-27/6/95, IR & DM.

Synuchus nivalis (Panzer). Avon Gorge SSSI, near Bo'ness, West Lothian, pitfall trap in deciduous woodland (NS9778), V.C.84, 8/10/95, AR.

Agonum viduum (Panzer). Lochdochart farm, near Crianlarich, pitfalls in grazed upland pasture (NN3825), V.C.88, 2/5-7/6/95, 7/6-30/6/95, IR & DM.

A. moestum (Duftschmid). Lochdochart farm, near Crianlarich, pitfalls in grazed upland pasture (NN3825), V.C.88, 2/5-7/6/95, 7/6-30/6/95,IR & DM. This is the first Scottish record of a species previously confused with *A. viduum* (Ribera *et al.*, 1996).

Amara eurynota (Panzer). Carsehead farm, near Crieff, pitfalls in arable field (NN9522), V.C.88, 24/7-28/8/95; Carsehead farm, near Crieff, in arable field and set aside (NN9523), 30/5-27/6/95, 27/6-24/7/95, 24/7-28/8/95, IR & DM.

Harpalus quadripunctatus Dejean. Carsehead farm, near Crief, pitfalls in set aside (NN9523), V.C.88, 24/7-28/8/95, IR & DM.

Dicheirotrichus gustavi Crotch. Bo'ness, West Lothian, several adults at fringe of saltmarsh under rocks (NS9881), V.C.84, 29/7/95, AR.

Cymindis vaporariorum (L.). Abercairny farm, near Crieff, pitfalls in heather moorland (NN9225), V.C.88, 3/5-30/5/95, 30/5-27/6/95, 27/6-24/7/95, IR & DM.

DYTISCIDAE

Hydroporus longicornis Sharp. Carsphairn Forest, Kirkcudbrightshire (NS5501), V.C.73, 12/3/95, GNF; Muir Toll, Campsie Fells, Stirlingshire (NS6382), V.C.86, 6/5/95, GNF; Achnaloich, Skye (NG5908), 27/5/95, GNF; Glen Arnisdale, West Inverness, (NG8409), V.C.97, 14/5/95, RHD. These records are all from valley mires.

Deronectes latus (Stephens). Glenmore River, Glenelg, West Inverness (NG818197), V.C.97, 28/5/95, GNF.

Agabus biguttatus (Olivier). Buskin Burn, Coldingham, Berwickshire (NT917663), V.C.81, 25/7/95, GNF & MS.

SPHAERITIDAE

Sphaerites glabratus (Fabr.). Coilsholm Woods, Ayrshire, pitfall traps (NS459258), V.C.75, 20/5/95, FP.

STAPHYLINIDAE

Olophrum piceum (Gyllenhall). Bo'mains Meadow SSSI, near Bo'ness, West Lothian, under rock in wet flush area (NS9879), V.C.84, 16/3/95, AR.

Deleaster dichrous (Gravenhorst). Avon Gorge SSSI, near Bo'ness, West Lothian, two adults under stone on shingle bank (NS9778), V.C.84, 6/5/95, AR.

Bledius subniger Schneider. John Muir Country Park, East Lothian, in sand near tidal burn (NT641789), V.C.82, 22/6/95, MS.

Ontholestes tessellatus (Fourcroy). West Philipstoun farm, Old Philipstoun, West Lothian, in dry horse manure (NT0577), V.C.84, 24/6/95, AR.

Aleochara ruficornis Gravenhorst. Coilsholm Woods, Ayrshire, pitfall traps (NS462257), V.C.75, 20/5/95, FP.

HETEROCERIDAE

Heterocerus flexuosus Stephens. John Muir Country Park, East Lothian, in sand near tidal burn (NT641789), V.C.82, 22/6/95, MS.

H. maritimus Guérin-Méneville. John Muir Country Park, East Lothian, in sand near tidal burn (NT641789), V.C.82, 22/6/95, MS.

NITIDULIDAE

Glischrochilus quadripunctatus (L.). Hannaston Wood, Dumfriesshire, under birch bark, (NX5982), V.C.72, 23/4/95, EGH.

EROTYLIDAE

Triplax aenea (Schaller). Perrays Wood, Hawthornhill, Dumbarton, in fungi on tree (NS374766), V.C.99, 6/5/95, AMcGS.

COCCINELLIDAE

Aphidecta obliterata (L.). Vale of Leven Industrial Estate, Dunbartonshire, large numbers on Larch, Sitka Spruce and Douglas Fir (NS396780), 22/8/95; Greenbank Garden (National Trust), Glasgow, on Oak but Larch adjacent(NS5657), 5/9/95, SE.

CHRYSOMELIDAE

Cryptocephalus bipunctatus (L.). Kinnoul Hill, Perthshire (NO1322), V.C.89, 4/6/95, KB.

Cassida flaveola Thunberg. Rousland farm, Bo'ness, West Lothian, swept from marshy area in woodland clearing (NS9779), V.C.84, 9/7/95, AR.

CURCULIONIDAE

Otiorhynchus desertus Rosenhauer. Galasheils, Selkirkshire, in garden (NT133359), V.C.80, 20/9/95, AB.

HYMENOPTERA

TENTHREDINIDIDAE

Nematus pavidus Lepeletier. Lesser willow sawfly. Bonnanhill, nr Strathaven, Lanarkshire, V.C.77, 13/8/95, EGH. An ornamental *Salix* cultivar was completely defoliated by the larvae.

CYNIPIDAE

Diplolepis rosae (L.). Bedeguar gall. Lochloy, Nairn, on *Rosa* sp. along roadside (NH9258), V.C.96, 20/7/95, SM.

FORMICIDAE

Lasius flavus (Fabr.). Formakin Estate, Renfrewshire, mounds common in one area of rough pasture, V.C.76, 10/7/95, EGH.

APIDAE

Bombus monticola Smith. Meall nan Tarmachan and Ben Lawers, Perthshire, very common over lower slopes, V.C.88, 16/6/95, EGH.

DIPTERA

TIPULIDAE

Tipula cheethami Edwards. Meall nan Tarmachan, Perthshire, V.C.88, 16/6/95, EGH.

Limonia (Dicranomyia) caledonica (Edwards). Meall nan Tarmachan, Perthshire, V.C.88, 16/6/95, EGH.

Dactylolabis sexmaculata (Macquart). Meall nan Tarmachan, Perthshire, V.C.88, 16/6/95, EGH.

SCIARIDAE

Plastosciara pernitida Edwards. Glasgow, in office building in city centre, V.C.77, 22/3/95, EGH. Large numbers had to be dealt with by the Environmental Services Department of Glasgow District Council.

SCATOPSIDAE

Apiloscatopse subgracilis Haenni & Greve. Crathie Burn, nr Balmoral, Aberdeenshire, at altitude of 545m, in heath with *Carex, Juncus, Sphagnum* and *Vaccinium* (NO2397), 14/8/87, MSCH. Although collected a few years ago this species has only just been decribed as new to science (Haenni & Greve, 1995).

TABANIDAE

Tabanus sudeticus Zeller. Inverness, Aultnaskiach Avenue, dead on pavement (NH6644), V.C. 96, 14/7/95, SM; Inverness, Chapel Yard, dead on pavement, (NH6645), V.C.96, 26/7/95, SM.

SYRPHIDAE

Cheilosia chrysocoma (Meigen). Meall nan Tarmachan, Perthshire, one adult found below crags in exclosure, V.C.88, 16/6/95, EGH. This is a rare species which is known as far north as Perthshire but is normally associated with broad-leaved woodland.

C. illustrata (Harris). Meall nan Tarmachan, Perthshire, one adult below crags in exclosure, V.C.88, 16/6/95, SH. Subsequently, in October 1995, a return visit to the same site revealed larvae to be feeding on rootstocks of Common Hogweed *(Heracleum sphondylium)*, GER.

C. sahlbergi Becker. Ben Lawers, Perthshire (NN6341), V.C.88, 16/6/95, EGH. Adults of this montane hoverfly were fairly common over flushes.

CALLIPHORIDAE

Calliphora uralensis Villeneuve. Saltcoats, Ayrshire, V.C.75, 7/8/95, EGH. Larvae were received as an enquiry from Environmental Health Department, Cunninghame District Council, which had been found infesting cooked meat in a retail outlet. This species is distinctly northwestern in its distribution (see map in Davies & Laurence, 1992) and the only other known locality in southwest Scotland is Ailsa Craig.

MUSCIDAE

Phaonia exoleta (Meigen). Taymouth Castle, near Kenmore, Perthshire, two larvae in beech rot hole (NN7946), V.C.88, 17/6/95, EGH. The larvae of this fly are fully aquatic and are predatory on those of mosquitos, in this case the typical tree breeding species *Anopheles plumbeus* Stephens.

HIPPOBOSCIDAE

Melophagus ovinus (L.) Sheep ked. Hirta, St Kilda, V.C.110, 9/95, JP. Because the sheep on St Kilda are not dipped the sheep keds and other parasites are at natural population levels on their hosts. On the mainland they are of uncertain status as a result of treatment.

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THE DISTRIBUTION OF THE MILLIPEDE, *Glomeris marginata* (Villers)

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The common pill millipede, *Glomeris marginata,* is the most easily recognized of the British millipedes, provided care is taken to distinguish it from the pill woodlice, *Armadillidium* spp., which can also roll up into a ball. The only other pill millipede in Scotland is the rare *Stygioglomeris crinita* Brölemann, which is very much smaller (c. 1 mm in diameter when rolled), white, blind and is usually buried in the topsoil. In contrast *Glomeris marginata* is dark and shiny, up to c.5 mm in diameter when rolled, and is usually easy to find in leaf-litter and under logs and stones in broad-leaved woodland, e.g. at the Falls of Clyde.

Although widely distributed in broad-leaved woodland in southern Scotland, *G. marginata* has so far never been found north of the Forth/Clyde (British Myriapod Group, 1988). It was therefore a surprise to find a colony at Wanlockhead, Dumfries-shire (NS 8613), the highest village in Scotland at c. 460 m. A half-hour search around the village on 21 June 1996 failed to find any millipedes other than a single *G. marginata.* (No millipede species are confined to high altitudes and only a few are normally found even around 500 m, mainly *Ommatoiulus sabulosus* (L.) and *Julus scandinavius* Latzel). A further half-hour on 23 June revealed three more *G. marginata* and still no other millipedes.

There is no woodland at Wanlockhead although there are some scattered trees, mainly sycamore and beech, and the *Glomeris* were found under stones on grass, grazed by sheep, about 10 m away from some beech trees. In contrast large numbers of stones on grass under beeches a few hundred metres away produced nothing.

During a survey for both pill millipedes and pill woodlice in the Lothians (Saville, 1995) *G. marginata* was found at 11 sites, the highest, and only non-woodland one, being at about 300 m on a roadside verge in moorland in the Moorfoot Hills, NT 3650, 28 April 1993 (B. Saville, pers. comm.). In a survey of the Sheffield area of the southern Pennines the highest record for *G. marginata* was at 330 m in scree at the top of a limestone dale (Richards, 1995 and pers. comm.). The ability of *G. marginata* to survive at Wanlockhead deepens the mystery of its apparent absence north of the Forth/Clyde. Perhaps it may turn up in some of the west Highland oakwoods; a considerable amount of searching in the wooded dens of Fife has so far failed to find it.

Incidentally the pill woodlouse *Armadillidium vulgare* (Latreille) has been recorded north of the Forth/Clyde only at a few localities on the Fife coast and one on the Tay Estuary near Dundee, so any 'pills' north of the Forth/Clyde are worth recording.

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Editors note: our referee queried the use of the word 'dens': should it be 'glens'? Dr Corbet notes that the word is current in Fife and Angus as meaning a small valley. The Concise Scots Dictionary (1985) gives its usage as general, but I have only heard it in East coast and Borders songs. Have any readers experience of this word in the West of Scotland?

GLASGOW NATURALIST Vol. 23 Part 2 pp 31-40 (1997)

AQUATIC HETEROPTERA OF SOME INNER HEBRIDEAN ISLANDS

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INTRODUCTION

There are few published records of aquatic bugs for any of the Inner Hebrides. For example, there are no records for Colonsay and Oronsay, few for Skye, and only one recent record each for Islay and Jura since a survey in 1922 (Hutchinson, 1923/1924). All the records for these islands in Walton (1942) originate from Hutchinson. To obtain a fuller picture of the distribution of aquatic bugs, visits were made to Colonsay and Oronsay (1-3 May), to Skye (14-16 May) and Islay and Jura (24-27 May) in 1996.

The number and distribution of the survey sites was restricted by the need to: (i) examine at least one site in as many 10km squares as possible in the time allowed, (ii) reduce walking to a minimum by surveying close to a road wherever possible and (iii) include as many different types of likely aquatic bug habitats.

The nomenclature is in accordance with Savage (1989) and the ordering of species names follows the Biological Records Centre recording card for aquatic Heteroptera (6433, Jan. 1984). For each island (or pair of islands in the case of Colonsay and Oronsay) there is a table listing numbered sites surveyed, proceeding broadly from north to south, and another table listing the species recorded for each numbered site.

COLONSAY AND ORONSAY

The 16 species recorded on Colonsay and Oronsay (Tables 1 & 2) were unsurprising, although the absence of the common species *Gerris costai* and *Gerris odontogaster* was unexpected. *Nepa cinerea* was found in a typically weedy habitat. Although females only of *Corixa iberica* were found, their determination was made with the aid of Savage (1989, 1991). *Sigara venusta* was found a few metres from the water scorpion in an unvegetated part of the same ditch where there was a slight flow over silt. These very small water boatmen have a tendency to hide in the bottom substrate and their capture is as much dependent on observation as facility with a net.

On Oronsay, the two sand dune lochs at NR360889 and NR354877 were examined but no aquatic bugs found, possibly due to the presence of green algae. The several concrete-edged reservoirs on Colonsay (cf site 11) appear to provide an important additional habitat for aquatic fauna.On Colonsay, the following lochs were not examined: Loch Breac (NR358910), Lochan a Braghad (NR416984), Fionn Loch (NR367944) and Dubh Loch (NR371946).

SKYE

The five species recorded before May 1996 are indicated in Table 4. *Gerris lacustris* was recorded (in an Inverness Museum list) by S.A. Moran at Loch nan Dunans, Flodigarry (NG467706) in 1983. *Corixa iberica* is shown as having been recorded in approximately the same NG47 10km square, in the map on page 123 in Savage (1989), as originating from Jansson (1986). The remaining three species records, for *Sigara distincta, S. nigrolineata* and *S. scotti* were made by D.J. Jackson in 1949 (specimens in Royal Museum of Scotland) all from several localities in grid square NG61 and also, for *S. nigrolineata,* in a peat pool near Loch Coruisk in NG42.

These five species were recorded again in 1996 as listed in Table 4 for the sites listed in Table 3. Regarding new records, as well as two for *Gerris lateralis,* there were four for the toothed skater *Gerris odontogaster* which is interesting as this species was not recorded in Colonsay nor Islay and Jura a few weeks before and after the Skye visit. On the other hand, whereas these other islands provided both *Notonecta glauca* and *N. obliqua,* the latter species only was recorded in Skye. Interesting also, as there are several records for *Micronecta sp.* in the Scottish islands, nymphs were found swarming in three lochs (all in typical habitats: coarse gritty shores with *Littorella* lawns). In two weeks in a home aquarium, a few survived to become adult *Micronecta poweri.* The records for *Glaenocorisa propinqua* and *Arctocorisa carinata,* and also one of the records for *Callicorixa wollastoni* (three species often found together when found at all) came from a small lochan at 180 metres altitude with fringing submerged vegetation somewhat similar to a lochan on Arran where these three species were found a year earlier (Huxley, 1996).

ISLAY AND JURA

The 1996 results are summarised in Tables 7 and 8 for the sites listed in Tables 5 and 6. Part of a day only was spent on Jura, so the list for this island is poor in comparison with that of Hutchinson (1923/24). There are two other recent records for *Nepa cinerea* in the neighbourhood of Loch Tallant on Islay (NR448506) by Dr Olivia Lassière, in 1994, and for *Gerris costai* in a *Sphagnum* pool at the Loch a' Mhulinn Site of Special Scientific Interest on Jura (NR6084) in 1991 (recorded in the Joint Nature Conservation Committee's Invertebrate Site Register).

For Islay, Hutchinson recorded 20 species, all but three of which were probably recorded again in May 1996. Species not recorded were *Gerris costai, Arctocorisa carinata* and *Sigara fossarum.* Hutchinson's record for *Corixa punctata* was almost certainly for *Corixa iberica,* which in 1922 was not distinguished from *punctata. Velia saulii* is another aquatic bug which was not separately distinguished in Britain until much later (Brown, 1951). It was found in 1996 in small numbers in the shallows of Loch Lossit, in a part where there was no emergent vegetation, ample surface prey and conditions calm with bright sun, enabling this little water cricket to be seen in its typical habitat. This species is exceptional in that it is the females rather than the males which are most easily distinguished in the field from its congener *V. caprai.*

Two other species recorded in 1996 are worthy of comment. Two males of *Sigara falleni* were found in Loch

Table 1:

Site No.	Grid Reference	Name	Brief description
		Colonsay	
1	NR408977	Lochan Gainmhich	small, shallow, almost drained, weedy
2	NR385970	Loch an Sgoltaire	11ha, dam, collected from southern marshy part
3	NR385970	*Potamogeton* ditch	near above
4	NR384969	Abhainn nan Toiteanan	outflow burn over rocks, with vegetation
5	NR389970	Kiloran reservoir	small, shallow, much silt, bog-bean
6	NR394966	Kiloran pond	0.25ha, ornamental, weedy, trees around
7	NR388958	Loch Fada, mid	40ha, collected from east end in shallows, reeds
8	NR372952	Loch Fada, west	30ha, collected from west end in shallows, reeds
9	NR393954	Turraman Loch	2.5ha, in moorland hollows, hard bottom
10	NR383948	Loch an Squid	1.5ha hill lochan, bog-bean, sedges
11	NR383943	Colonsay Hotel Reservoir	small, concrete edged, weedy
12	NR368938	Lochan Gleann Raonabuilg	0.75ha hill lochan surrounded by reeds
13	NR368938	outfall burn, peat pools	near Lochan Gleann Raonabuilg
14	NR358937	Tobar Fuar	burn through dunes
15	NR380920	Loch Cholla	2.5ha in open moorland, deep water, reeds
16	NR378921	roadside ditch	*Potamogeton*, no flow
17	NR378921	roadside ditch	little vegetation, slight flow over silt
18	NR375915	roadside burn	through moorland, over rocks
		Oronsay	
19	NR363895	burn	running to sea, near the Strand
20	NR350890	Priory reservoir	small, concrete edged, thickly weedy

Table 1: Colonsay and Oronsay; list of sites surveyed.

Site Number

Species	Colonsay																		Oronsay
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Velia caprai Tamanini				+									+	+				+	+	
Gerris lacustris (Linnaeus)		+		+		+	+	+			+		+					+		+
Nepa cinerea Linnaeus																+				
Notonecta glauca Linnaeus			+		+															
Notonecta obliqua Gallen																+				
Cymatia bonsdorffi (Sahlberg)									+						+					
Corixa iberica Jansson					+							+								
Hesperocorixa castanea (Thomson)	+				+						+									+
Hesperocorixa linnaei (Fieber)					+	+														+
Hesperocorixa sahlbergi (Fieber)						+										+				+
Callicorixa praeusta (Fieber)											+									
Sigara distincta (Fieber)								+	+	+		+								
Sigara dorsalis (Leach)		+	+	+		+	+	+	+	+										
Sigara scotti (Douglas & Scott)		+	+	+		+	+	+	+	+					+					
Sigara semistriata (Fieber)			+		+	+														
Sigara venusta (Douglas & Scott)																	+			

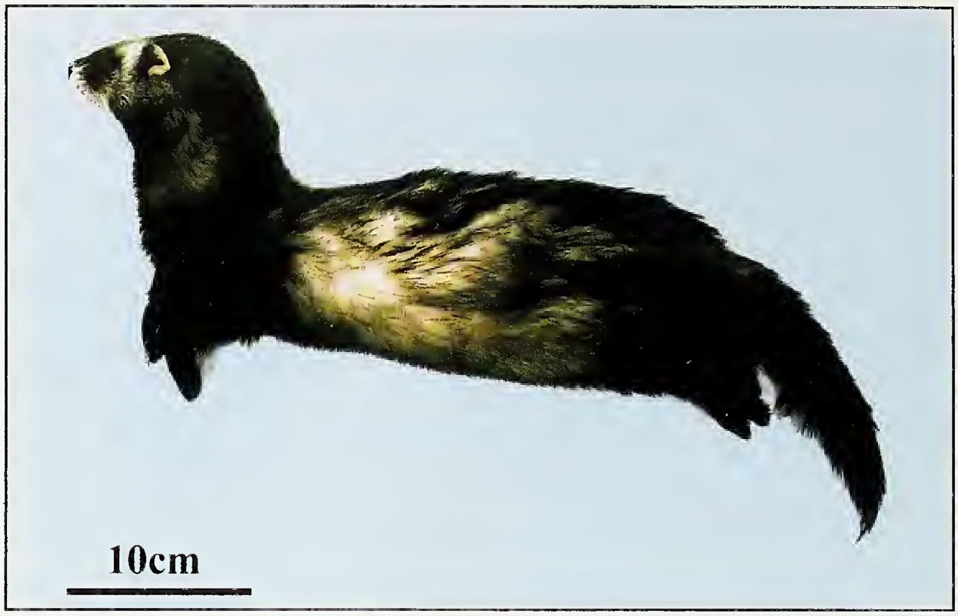
Table 2: Colonsay and Oronsay; + = species recorded in numbered sites, May 1996

Site No.	Grid Ref	Name	Brief Description
North: Trotternish			
1	NG416743	Duntulm Loch	1ha, shallow boggy edge, horsetail, bog-bean
2	NG465709	pond by road, Dunans	small, weedy
3	NG460707	burn nearby	over rocks in moorland
4	NG457695	Duntulm Loch	0.35ha hill lochan, mossy/stony bottom
5	NG470698	pond by road, Dunans	0.5ha, soft *Sphagnum* edge, *Potamogeton*
6	NG506655	Loch Mealt	28ha, sedge beds & Littorella over gritty bottom
7	NG494503	Storr Lochs (S end of L Leathan)	15ha, marshy edge to reeds
8	NG492491	Loch Fada	25ha, *Littorella* lawns over stony bottom
9	NG422481	River Snizort	vegetated muddy backwater in sharp bend
North: Waternish			
10	NG233605	Trumpan Loch	1.5ha, reedy edges, stony/silty bottom
11	NG233604	in ditch to south of Trumpan Loch	cut through peat
12	NG240509	Loch Suarda, N of Dunvegan	3.5ha reedy edge; near sea
Central			
13	NG472305	Loch nan Eilean, Slighachan	moorland lochan
14	NG472303	peat pools nearby	shallow, *Sphagnum*
15	NG472303	burn nearby	through peat
South			
16	NG680208	Lochain Dubha East	3.5ha, in moorland, sedges, bog-bean
17	NG681208	burn nearby	over stones
18	NG613205	Loch Cill Chriosd reed beds	17ha, reed beds over soft bottom
19	NG614206	Loch Cill Chriosd stony shallows	17ha, *Littorella* lawns over coarse grit
20	NG614204	burn nearby	across road from loch
Sleat			
21	NG658110	Loch Meodal	2.5ha, cattle grazed edges, sedges
22	NG658109	stagnant ditches nearby	in bog
23	NG675104	Loch nan Dubhrachan	2.5ha, *Eleocharis,* stony bottom, silty
24	NG593107	Loch Gauscavaig	4ha, stony bottom, *Juncus*
25	NG610081	Loch Dhùghaill	12ha, dam, moorland loch, peat banks
26	NG610081	outfall burn	over rocks
27	NG610082	peat pool nearby	shallow, small, algae
28	NG638045	Armadale Castle ponds	three small ornamental ponds with vegetation

Table 3: Skye; list of sites surveyed in May 1996.

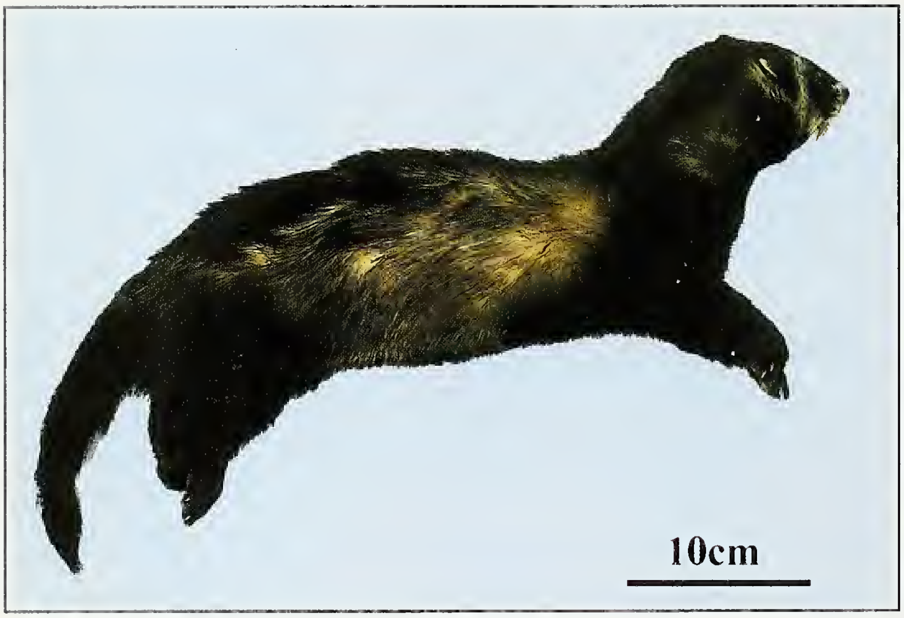
Species	North Trotternish									Waternish			Central			South					Sleat							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Velia caprai Tamanini			+								+		+		+		+			+		+	+	+		+		
Gerris costai (Herrich-Schaeffer)																											+	
Gerris lacustris (Linnaeus)*	+	+			+	+												+			+		+		+			+
Gerris lateralis Schummel							+															+						
Gerris odontogaster (Zetterstedt)										+				+		+						+						
Notonecta obliqua Gallen					+				+					+														
Micronecta poweri (Douglas & Scott)						N		N											N									
Cymatia bonsdorffi (Sahlberg)										+						+												
Glaenocorisa propinqua (Fieber)				+																								
Corixa iberica Jansson*					+																							
Hesperocorixa castanea (Thomson)				+	+					+						+					+							+
Hesperocorixa linnaei (Fieber)																												+
Arctocorisa carinata (Sahlberg)				+																								
Callicorixa wollastoni (Douglas & Scott)				+	+					+																		
Sigara distincta (Fieber)*										+		+																+
Sigara dorsalis (Leach)						+	+		+			+						+										
Sigara nigrolineata (Fieber)*														+														
Sigara scotti (Douglas & Scott)*	+				+	+				+		+	+			+		+			+		+					
Sigara semistriata (Fieber)									+			+									+							

Table 4: Skye; species: * = earlier records; + = records in numbered sites, May 1996; N = nymphs retained in aquarium.



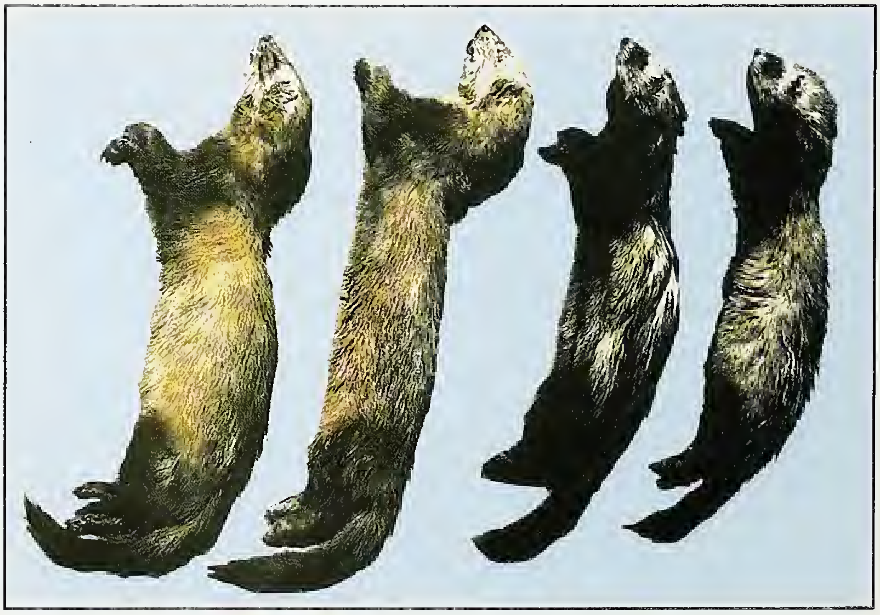
Scottish Polecat
(Putorius putorius)

female, Connel, Oban,
12th February 1995.



Welsh Polecat

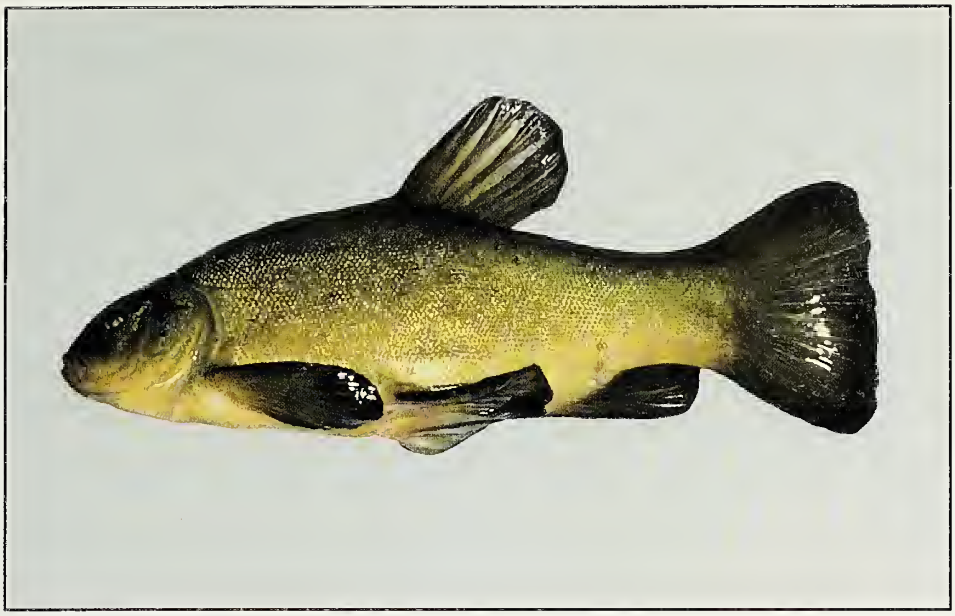
male, Rhayader,
22nd September 1994.



Feral Ferrets

Feral ferrets from the
island of Islay,
November 1987

(two on right are females:
two on left are males)



Tench
(Tinca tinca)

adult male,
Loch Lomond,
January 1997.

photo: Alan Grant

Lacewing
(Drepanepteryx phalaenoides)

Roslin Glen,
Midlothian,
25th August 1996.

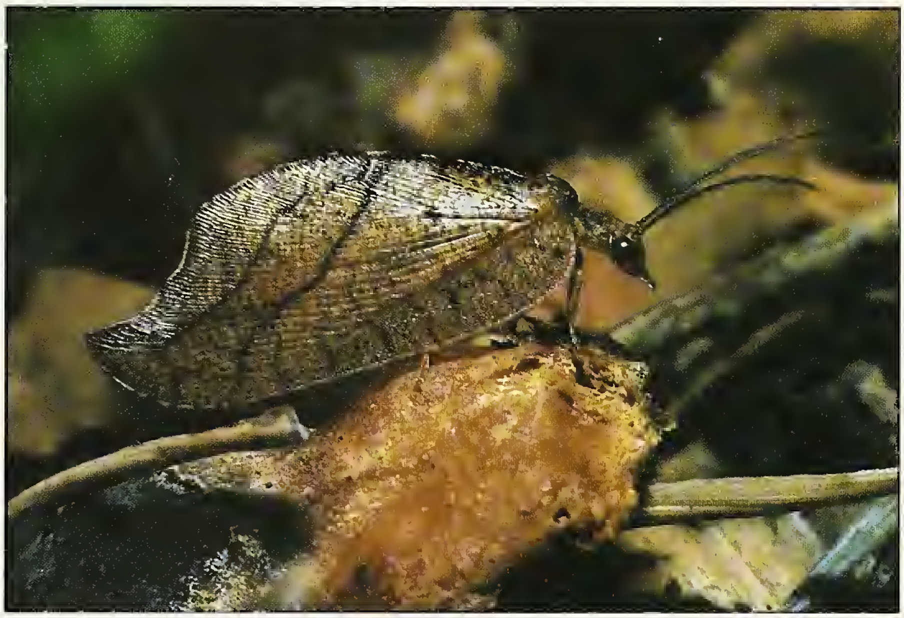
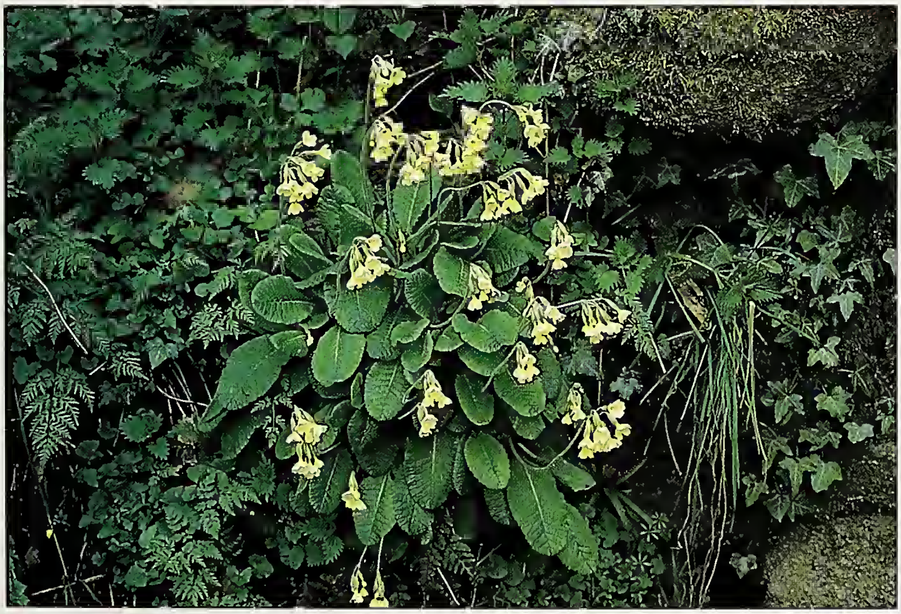


photo: Val Muirhead



Oxlip
(Primula elatior)

on banking,
upstream from Dalserf,
Lanarkshire 1996.

photo: Peter Macpherson

Site No.	Grid Ref.	Name	Brief Description
1	NR285727	Ardnave Loch	9ha, near coast, sandy bottom, bog-bean
2	NR405709	Loch Staoisha	10ha, reedy/marshy southern end
3	NR243658	Loch Gorm	200ha, in weedy bays, sandy bottom
4	NR318628	Rubha Ban	marshy lochan in stock grazed coastal area
5	NR353633	River Sorn, near Mill	edge of slow flowing river with overhanging vegetation
6	NR344636	Loch Skerrols	21ha, eastern part beyond wooded shore, sedges
7	NR407650	Loch Lossit	12ha, in marshy/sedge southern part
8	NR407655	Loch Lossit	12ha, shallow, stony western shore
9	NR407650	Loch Lossit, nearby	in feeder burn
10	NR425684	Loch Allan	1ha northern wooded part (= Lily Loch)
11	NR425688	Port Askaig	0.3ha lochan, surrounded by marsh
12	NR430687	Port Askaig	0.25ha weedy reservoir lochan, in woodland
13	NR166538	Claddach, north of	1.5ha, in open grazed fields, reeds and sedges
14	NR205534	Easter Ellister	main 1ha loch in field, dam
15	NR203533	Easter Ellister	small weedy pond downstream of main loch
16	NR203533	Easter Ellister	weedy pond on landward side of road from main loch
17	NR201535	Easter Ellister	in burn near farm
18	NR314555	Loch Airigh Dhaibhaidh	1ha moorland lochan, sedge edge
19	NR327518	Glenegedale (nearby)	0.5ha lochan in peat (near airfield)
20	NR295429	Kinnabus	small weedy dam reservoir, muddy bottom
21	NR373487	Leorin Lochs (west)	3.5ha moorland loch
22	NR373490	Leorin Lochs, nearby	peat pool
23	NR376489	Loch Laoim	1ha, narrow, dark, stony edge
24	NR448506	Loch Tallant	1.5ha moorland loch, marshy edge
25	NR447506	nearby above	peat pools and ditches

Table 5: Islay; list of sites surveyed May 1996.

Site No.	Grid Ref	Name	Brief Description
1	NR604837	Loch a' Mhuilinn (west)	1ha, moorland loch, narrow, dark peaty water, stony edge
2	NR605835	Loch a' Mhuilinn (east)	3.5ha, moorland loch, narrow, marshy end
3	NR605835	near above lochs	burns in peat
4	NR518669	Loch a' Mhuilinn, Craighouse	2ha reservoir lochan in moorland, stony edge in part
5	NR486635	Jura House garden	burn through garden
6	NR441694	near ferry pier	burn to sea over rocks

Table 6: Jura; list of sites surveyed May, 1996

Species	Islay: Site Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Velia caprai Tamanini *				+				+								+								
Velia saulii Tamanini							+																	
Gerris costai (Herrich-Schaeffer) *																					+			
Gerris lacustris (Linnaeus) *	+	+		+		+			+		+	+		+			+	+						+
Gerris thoracicus Schummel															+									
Nepa cinerea Linnaeus *																								
Notonecta glauca Linnaeus *												+			+									
Notonecta obliqua Gallen *											+	+							+					
Micronecta poweri (Douglas & Scott)*																								
Cymatia bonsdorffi (Sahlberg) *						+							+										+	
Glaenocorisa propinqua (Fieber) *												+								+		+		
Corixa punctata (Illiger) *																								
Corixa iberica Jansson			+								+	+			+									
Hesperocorixa castanea (Thomson) *														+			+	+						
Hesperocorixa linnaei (Fieber)														+										
Hesperocorixa sahlbergi (Fieber) *											+													
Arctocorisa carinata (Sahlberg) *																								
Arctocorisa germari (Fieber) *												+	+							+		+		
Callicorixa praeusta (Fieber) *												+	+											
Callicorixa wollastoni (Douglas & Scott) *																				+		+		
Sigara concinna (Fieber)													+											
Sigara distincta (Fieber) *	+											+	+		+				+					
Sigara dorsalis (Leach) *	+			+	+				+								+							
Sigara falleni (Fieber)					+																			
Sigara fossarum (Leach) *																								
Sigara lateralis (Leach)			+																					
Sigara nigrolineata (Fieber) *											+			+					+					+
Sigara scotti (Douglas & Scott) *	+					+			+	+							+	+						
Sigara semistriata (Fieber)						+								+				+	+					
Sigara venusta (Douglas & Scott) *																		+						

Table 7: Islay; species: (= earlier records, + = records in numbered sites May 1996.

Species	**Jura: Site Number**					
	1	**2**	**3**	**4**	**5**	**6**
Velia caprai Tamanini*			+		+	+
Gerris costai (Herrich-Schaeffer)*						
Gerris lacustris (Linnaeus)*		+				
Cymatia bonsdorffi (Sahlberg)*	+	+		+		
Glaenocorisa propinqua (Fieber)*	+					
Corixa punctata (Illiger)*						
Hesperocorixa castanea (Thomson)*	+	+				
Hesperocorixa sahlbergi (Fieberg)*						
Arctocorisa carinata (Sahlberg)*						
Arctocorisa germari (Fieber)*						
Callicorixa praeusta (Fieber)*						
Callicorixa wollastoni (Douglas & Scott)*	+					
Sigara distincta (Fieber)*						
Sigara dorsalis (Leach)*						
Sigara scotti (Douglas & Scott)*	+	+		+		

Table 8: Jura; species recorded in numbered sites; * = earlier records, + = records in numbered sites May 1996.

Skerrols and, although this is one of the commonest species on the Scottish mainland, there are few records for the islands. Walton (1942) found it but once in the Heslop Harrison collections (from Eigg, 1938) and states that "apart from this solitary specimen there are no other Hebridean records". Finding *Sigara lateralis* at the Rhuba Ban coastal site was also of interest. Hutchinson recorded it from Gigha and Walton found "one typical female among a long series of Corixidae taken in North Uist in 1938". There is also a record by Waterston in 1937 for this species from near Lagg, Arran, and Clifton (1984) recorded it at "three coastal sites" on Rum, so it does occur sporadically in the islands.

Other species found in 1996 but not recorded by Hutchinson were *Gerris thoracicus, Hesperocorixa linnaei, Sigara concinna* and *Sigara semistriata.*

Jura clearly requires further investigation. Hutchinson names the loch $^3/4$ mile west of Craighouse as 'Craighouse Loch'; it is presumed that this is the same as the reservoir loch named 'Loch a' Mhuilinn' on the latest 1:50000 OS map. In 1996 only two of the five species recorded by Hutchinson were found.

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A REVIEW OF RECENT RESEARCH ON THE PERCIDS,PERCH *PERCA FLUVIATILIS* L. AND RUFFE *GYMNOCEPHALUS CERNUUS* (L.), IN SCOTLAND

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INTRODUCTION

The perch, *Perca fluviatilis* L., was the only percid species found in Scottish freshwaters prior to 1982 (Maitland & Campbell, 1992). As salmonids are the main commercial and sport fishes in Scotland and have also dominated the aquaculture industry, perch fisheries have little economic value, unlike in England, and have consequently remained largely unexploited and unmanaged. Another major feature of perch stocks in Scotland is their occurrence in simple fish communities. The likely reason for this is that, following the last glaciation approximately 10,000 years ago, fishes colonised the British Isles northwards from the southern tip of England (Maitland, 1977). Expansion to Scotland was slow and by 1790 only 15 freshwater species had been recorded. Although there is little commercial interest in perch, the species is one of the commonest and most widely distributed fishes in lacustrine habitats in lowland Scotland (Maitland, 1972).The extent of competition with salmonids for food has not been quantified, but perch in Loch Leven (Thorpe, 1977a) and in Loch Tummel (Campbell, 1955) consumed food items that were also major prey items of brown trout *Salmo trutta* L., although only seasonally. Perch larvae have also a significant impact on zooplankton communities, cropping up to 29% of *Cyclops strenuus abyssorum* biomass per day and 27% of *Diaptomus gracilis* in two Deeside lochs (Treasurer, 1992).

Research on percids in Scotland has dealt with the age and growth of perch in Loch Lomond and Dubh Lochan (Shafi, 1969; Shafi & Maitland, 1971), the daily food consumption of perch in Loch Leven, Kinross (Thorpe, 1977a), reproduction of perch in two Deeside lochs (Treasurer, 1981; Treasurer & Holliday, 1981) and Loch Leven (Jones, 1982), production in the egg stages (Treasurer, 1983), growth (Treasurer, 1988) and food (Treasurer, 1990a) of larvae, and studies of population dynamics (Treasurer, Owen & Bowers, 1992). The recent introduction of a second percid, the ruffe *Gymnocephalus cernuus* (L.), to Loch Lomond and its impact on the rare population of powan *Coregonus larvaretus* L. and on the pike *Esox lucius* L. has been recorded (Maitland & East, 1989; Adams & Tippett, 1991).A synopsis of data on perch was provided by Thorpe (1977b). This paper reviews the findings on percid biology in Scotland since that publication. It is based largely on the author's own work and focuses on three types of faunal community: perch in a simple fish species system with no top piscivore; perch in a simple predator-prey relationship with pike; ruffe in a more complex fish association. Methods employed by the author are summarised elsewhere (e.g. Treasurer, Owen & Bowers, 1992).

STUDY AREAS

With regard to simple fish communities lacking a top piscivore, the author has examined perch in two small and shallow lochs in North east Scotland (Fig. 1). Sand Loch is only 300m from the sea and the only other fish species present is the three-spined stickleback *Gasterosteus aculeatus* L.. Angling is not permitted as the loch is part of the Sands of Forvie National Nature Reserve. The second loch, Lower Loch, is 18.5 km due west of Sand Loch and was constructed as a duck shooting water in the nineteenth century. The loch is enclosed by mixed coniferous and deciduous woodland and dense *Phragmites communis* beds make access possible only by boat. Eel *Anguilla anguilla* L., and three-spined sticklebacks are common and brown trout rare. The loch is unfished and the local estate was unaware of the presence of perch in the loch.

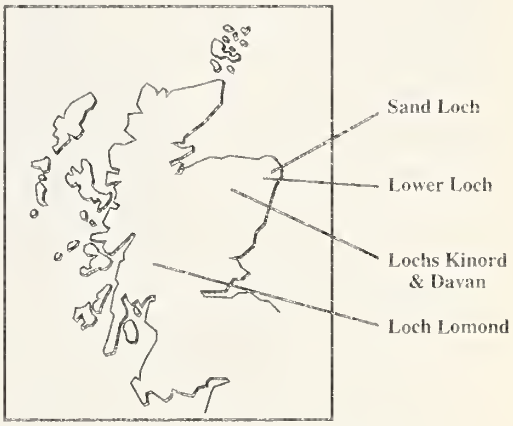


Figure 1. Locations of lochs mentioned in review

The author examined perch in a simple predator-prey association in Lochs Kinord and Davan in the Dee valley. Both are shallow (mean depth 1.5 m). Kinord has been classified as oligotrophic and Davan as slightly mesotrophic with some input of nitrate from agricultural land upstream of the main feeder stream. Eels and pike are common in both lochs. Both are part of the Muir of Dinnet National Nature Reserve and are rarely fished.

Perch and ruffe have also been studied in Loch Lomond (Maitland & East, 1989). This is the largest lake in the British Isles with an area of 71 km^2 and a mean depth of 37 m. It has the most diverse fish fauna in Scotland with 18 species recorded. It is in an area of Special Scientific Interest, is important recreationally, and has a coarse fishery.

Simple fish communities without a top piscivore

Growth of perch in Sand and Lower lochs is faster than in most other British waters (Table 1). Greater lengths at each age are only found in Cheshire lakes where fast growth is attributed to high food availability and low perch abundance (Goldspink & Goodwin, 1979), and also in the River Stour,

Table 1: Mean length-at-age of perch in Scottish lochs compared with other lakes and rivers in Britain

Lake/river	Length (mm) at age:															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Kinord, males	55	89	137	179	213	235	251	244	256	263	270	277	283	290	295	299
females[1]	54	88	142	188	223	248	266	274	283	283	287	290	295			
Davan, males	63	100	149	175												
females[1]	62	100	157	202	239	267	284	297	282	292	301	310	316	320	326	329
Sand, males	62	128	180													
females[2]	62	128	185	232	255											
Lower, males	82	157	198	232												
females[2]	79	157	206	242	267											
Lomond[3]	67	107	143	165	186	204	220	241	273	314	340	361	375			
Dubh Lochan[3]	51	76	94	108	120	131	143	152	164	172	181					
Windermere[4]	76	112	147	173	192	198	230									
Ullswater[5]	64	114	144	165	177	185	191	194	197	199						
Llyn Tegid, males	56	88	115	129	143	157	168	182	194	211						
females[6]	55	88	115	134	151	165	178	191	203	216						
Cheshire Meres[7]	94	155	214	272	308	331	346	358	367	382	390					
Slapton Ley[8]	75	122	155	189	220	242										
R. Stour males	74	152	205	250	273	295	310	326								
females[9]	75	164	226	269	296	314	319	330	338	346						
R. Thames[10]	69	92	111	122	137	155	169	187								
East Anglia[11]	58	86	111	147	165											

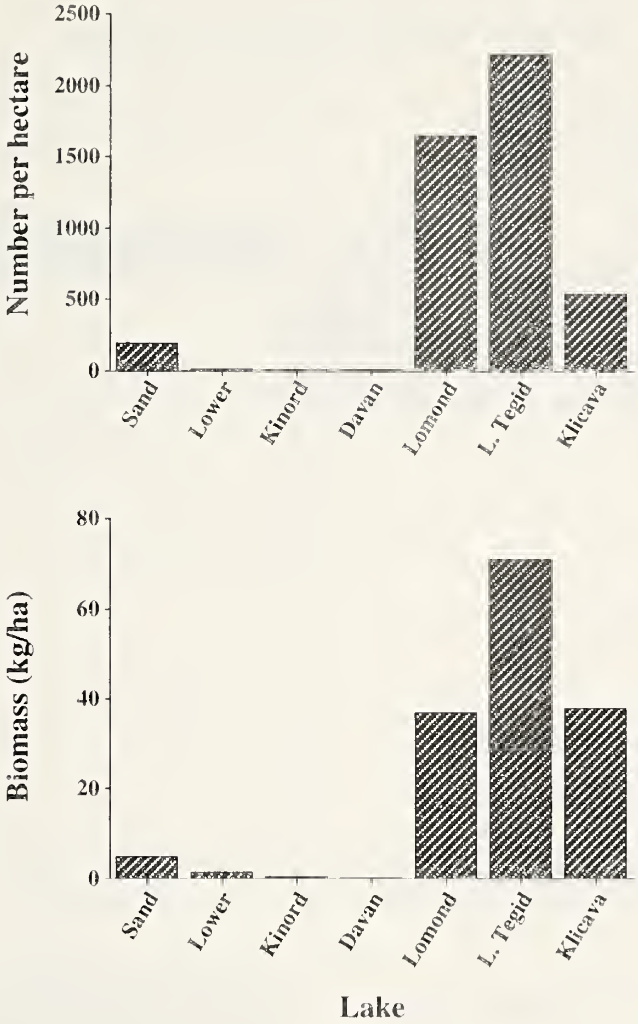
Authorities: 1 = Treasurer, 1980; 2 = Treasurer, 1993; 3 = Shafi & Maitland, 1971; 4 = Le Cren, 1958; 5 = McCormack, 1965; 6 = Ali, 1973; 7 = Goldspink & Goodwin, 1979; 8 = Craig, 1974; 9 = Mann, 1978; 10 = Williams, 1967; 11 = Hartley, 1947

Table 2: Numbers and production (kg wet weight/annum) of perch populations

Lake/river	Age groups (years)	N/ha	P kg/ha
Kinord[1]	3 - 17	4.8 - 9.8	0.32 - 0.39
Davan[1]	3 - 17	6.6	0.2
Sand[2]	>2	207	5.4
Lower[2]	>2	16	1.1
Lomond[3]		1649 - 1695	34 - 39
Leven[4]		2 - 9	27.9
Windermere[5]		>2	30 - 492
Llyn Tegid[6]		2210	70.5
R. Thames[7]		2400	23
R. Nene[8]			7
Klicava[9]		210 - 880	14 - 62

Authorities: 1 = Treasurer, Owen & Bowers, 1992; 2 = Treasurer, 1993; 3 = Shafi, 1969; 4 = Thorpe, 1974; 5 = Le Cren *et al*, 1977; 6 = Ali, 1973; 7 = Williams, 1965; 8 = Hart, 1971; 9 = Oliva & Holcik, 1965

Figure 2 Numbers and production of adult perch > 3 years old, in Scottish lochs compared with Llyn Tegid and the Klicava reservoir. Data from L. Lomond (Shafi, 1969); Llyn Tegid (Ali, 1973); Kilcava (Oliva & Holcik, 1965).



Dorset (Mann, 1978) because of low density of perch and early piscivory by young perch on cyprinid juveniles. Treasurer (1993) concluded that high growth rates in perch in simple fish associations in North east Scotland were due to low biomass coupled with nutrient enrichment and availability of sticklebacks as prey. Numbers and production of adult perch were low in these lochs (Treasurer, 1993) compared with perch found in more diverse fish communities in Britain (Table 2). Treasurer (1993) concluded that, in the absence of a top piscivore, the abundance of perch is suppressed by cannibalism by adults as cannibalism has been shown to be a key regulatory mechanism in perch (Menshutin & Zhakov, 1964).

Perch and pike in a simple-predator prey association

Treasurer (1983) estimated the numbers of adult perch as 4.8 - 9.7 ha^{-1} in Loch Kinord and 5.5 ha^{-1} in Loch Davan and production as 0.32 - 0.39 and 0.20 kg ha yr^{-1} respectively, similar to Sand and Lower lochs (Fig. 2). Growth rates were high for highland lochs (e.g. Table 1), possibly as a result of low numbers. All age classes were were represented in samples with little fluctuation in year class strength (Fig. 3). This can be compared to many perch populations which are dominated by strong year classes and which can be subject to wide variations in year class strength, up to 300-400 times, as found in perch in the Lake District (Kipling, 1976).

The extent of losses of 0+ perch to cannibalism and predation by pike was assessed by the author from the decline in numbers of larvae in a high speed plankton sampler and in a seine net in the juvenile period (Treasurer, 1989). Perch larvae were present in the diet of perch from 1 June and contributed a large proportion (59-63%) of the diet through the larval period (Fig. 4). Larvae were not found in the stomachs of pike but perch were taken on transition to the juvenile period c. 16 June. There was no indication of cannibalism in 0+ perch. Juvenile perch were important in the diet of perch and pike, contributing up to 80% occurrence of food items in adult perch and 90% in pike. The estimated decline in numbers of 0+ perch was compared with the estimate of larvae consumed by adult perch and pike on two dates and for juveniles on 3 occasions (Fig. 5). Comparison of the modelled values with the decline in numbers of 0+ perch indicates that cannibalism at Loch Kinord would have been responsible for a large proportion of the mortality of larvae. On transition to the demersal period on 16 July about 50% of perch mortality was attributed to predation divided almost evenly between perch and pike, with lower but significant losses on later

Figure 3. Age distribution of perch in simple fish communities, Sand Loch and Lower Loch and in Lochs Kinord and Davan with a simple predator-prey association of pike and perch

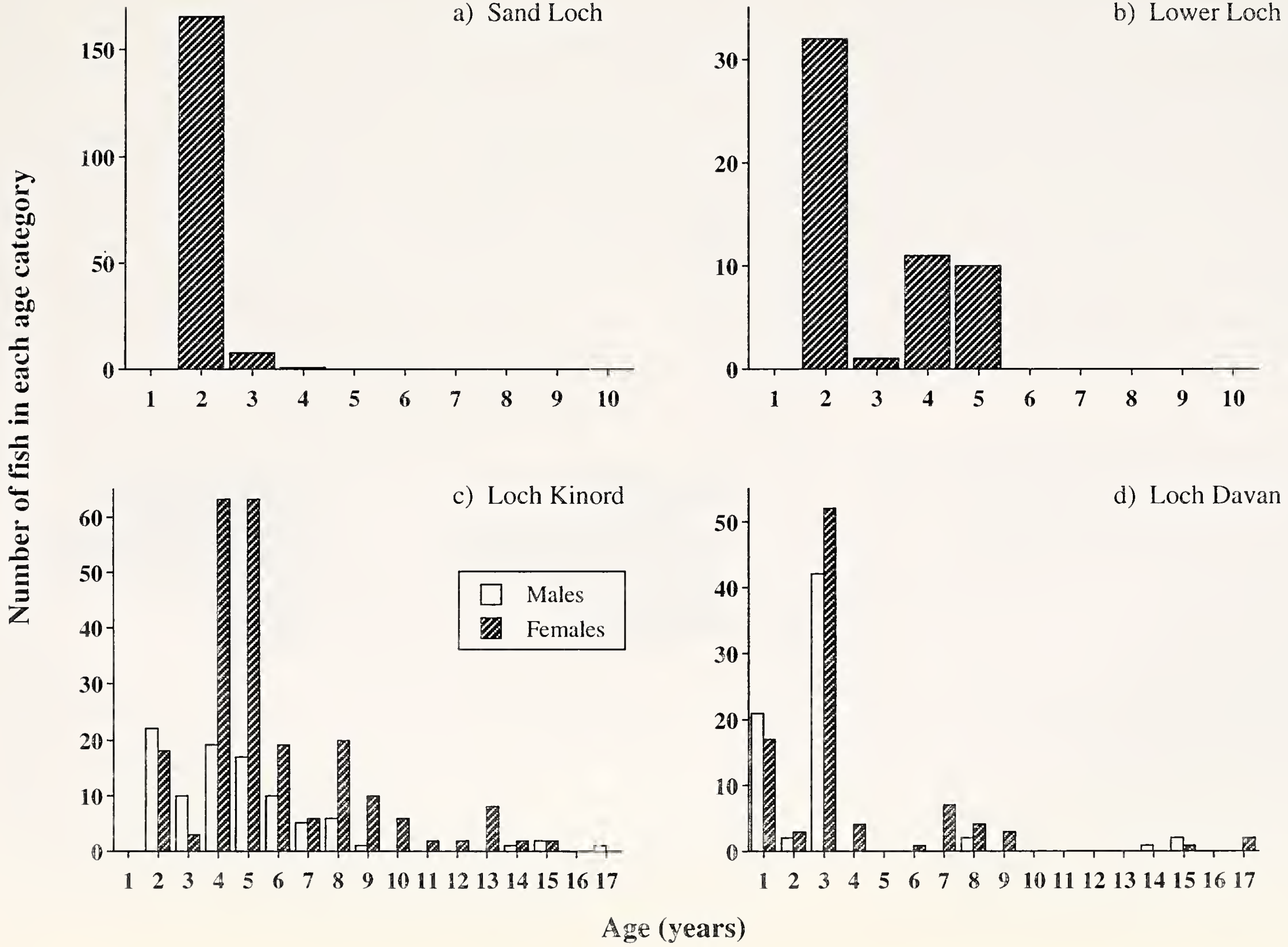
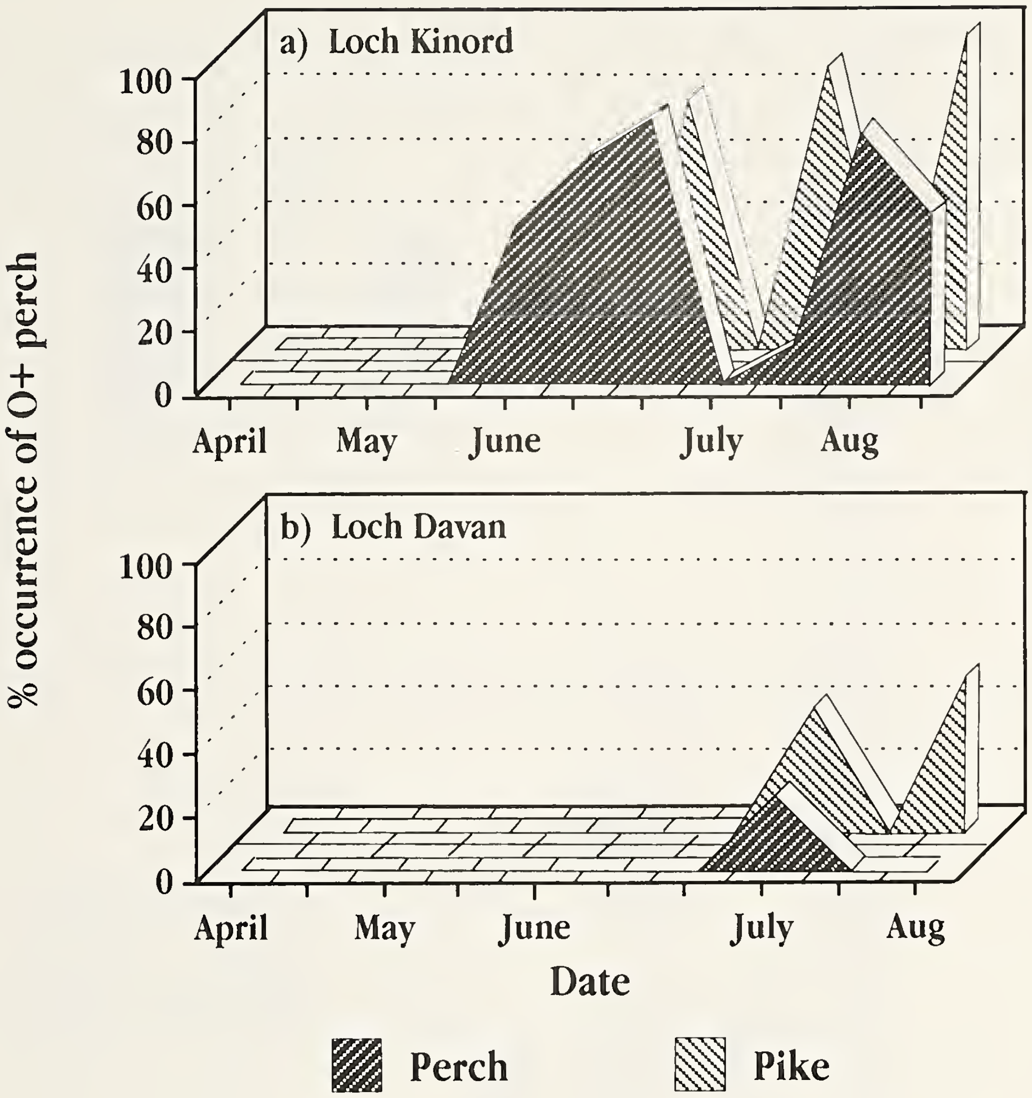


Figure 4 Percentage occurrence of 0+ perch in the diet of adult perch and pike in Lochs Kinord and Davan



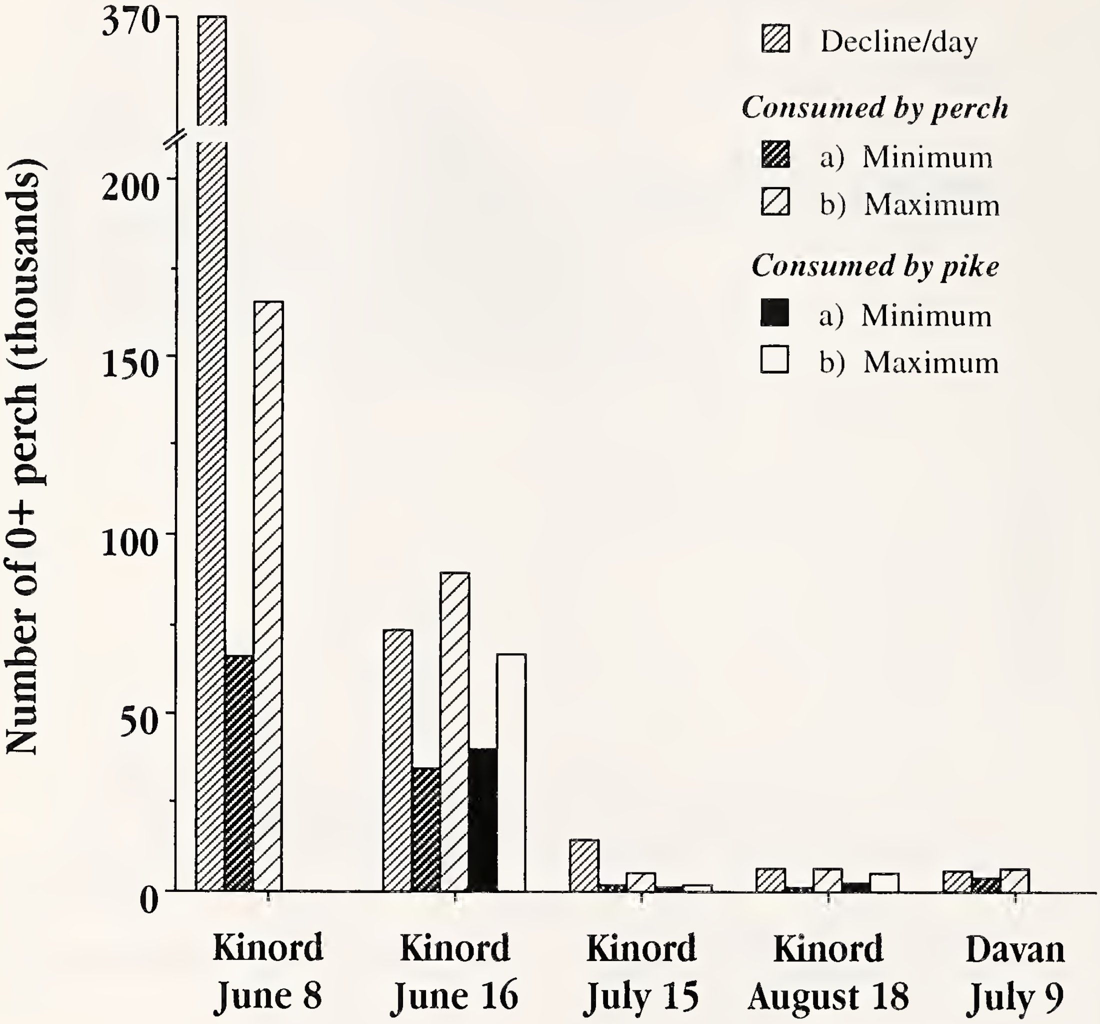
dates. At Loch Davan cannibalism accounted for all mortality of perch juveniles and predation by pike was less important (Treasurer, 1989).

Numbers and production of perch were lower than in many lakes in Britain and elsewhere (Table 2) although density and production of pike were similar to other European waters (Treasurer, Owen & Bowers, 1992). High predation pressure by pike on 1+ and 2+ perch as well as juveniles can be gauged from the ratio of numbers and biomass of pike to perch (Fig. 6). This is lower than the ratio of perch to pike in Windermere from 1941 to 1966 in the range of 8 to 44 which Le Cren et al. (1977) considered to indicate intense predation pressure. Therefore, the unusually low numbers and production of perch in the simple pike-perch associations in the Deeside lochs is due to a combination of intense predation by pike together with cannibalism.

More complex fish communities

The growth rate of the perch in Loch Lomond has been shown to be fast for European waters (Table 1). Although the loch is too large to obtain a population estimate by conventional means such as mark-recapture techniques (Shafi, 1969), the relative composition of fish species has been recorded from screens on pumped water from a water supply system. Perch dominated the catch in 1983, representing 69% of fish captured (Maitland, East & Morris, 1983; Maitland & East, 1989) when the ruffe was recorded in Scotland for the first time, probably having been introduced as livebait by anglers. The proportion of ruffe in the pumped water screens increased to 92% of catch by 1987 (Maitland & East, 1989) (Fig. 7). Concern has been expressed regarding the impact on native species such as the unique population of powan (Adams & Tippett, 1991). Powan eggs are important in the

Figure 5. Actual decline in numbers of 0+ perch at Lochs Kinord and Davan compared with estimated consumption by adult pike and perch



diet of ruffe (representing 84% by weight) and ruffe maintain a higher winter feeding rate than other predators of powan eggs, including powan themselves and brown trout. Similarily, ruffe numbers have increased dramatically in Lake Constance since they were introduced in 1987. They feed mainly on coregonid eggs during December and are thought to affect coregonid abundance (Rosch & Schmid, 1997). Introduced ruffe have rapidly colonised Bassenthwaite Lake in England and Llyn Tegid in Wales where nationally rare Coregonus species are also present (Winfield, Adams & Fletcher, 1997). The ruffe has recently colonised lakes in North America, having been accidentally introduced from Europe in 1986 in the ballast water of ships, with potential impact on native species (Savino & Kolar, 1996). This widespread expansion in the range of ruffe merits close scrutiny of possible further introductions in Scotland.

CONCLUSIONS

In the relatively simple fish communities in Scotland examined in recent investigations numbers, biomass and production of perch have been found to be low compared with perch in England and Europe. Low production of perch in Lochs Kinord and Davan is due to cannibalism of larval perch, and a combination of intense predation by adult perch and pike on juveniles. In lochs where pike were not present, production was similarily low and was regulated by cannibalism. Low biomass produces good growth rates and consequently, in the case of perch in simple fish systems, a short lifespan. As year class strength does not fluctuate greatly, biomass of adults (>3 years old) is stable from year to year. Although perch is not a main species for anglers in Scotland, the perch fishery is likely to expand slightly in the coming years, although unlikely ever to displace interest in salmonids. There has been intermittent discussion about the creation of a commercial fishery for coarse fishes including pike, eels and perch in the highlands. This has met local opposition from salmonid anglers as salmonids could not be avoided as a bye catch, as the fishery for these coarse species could

Figure 6 A comparison of the numbers and biomass of pike (>2 years) and perch (>3 years) in Lochs Kinord and Davan

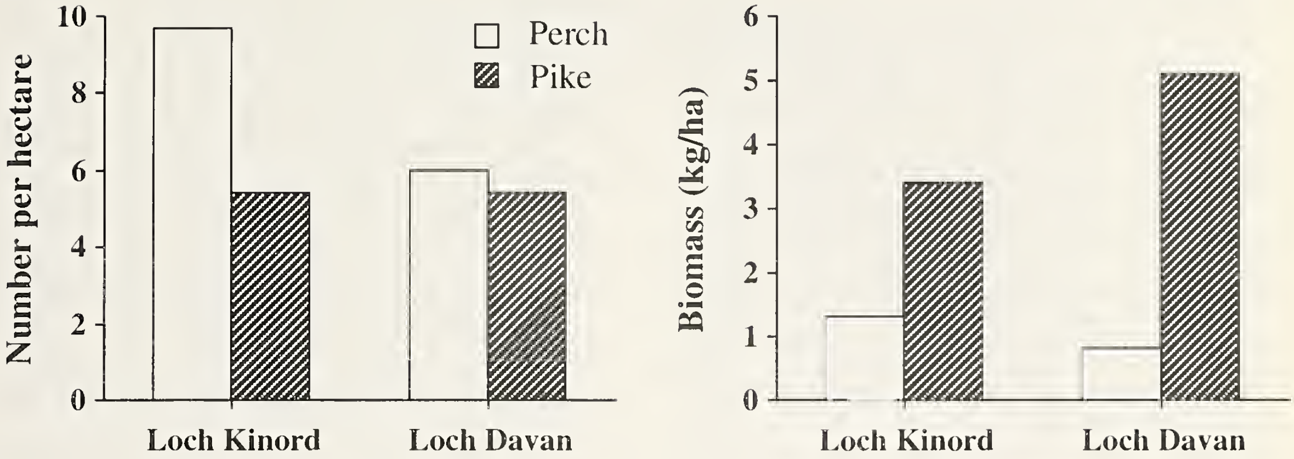
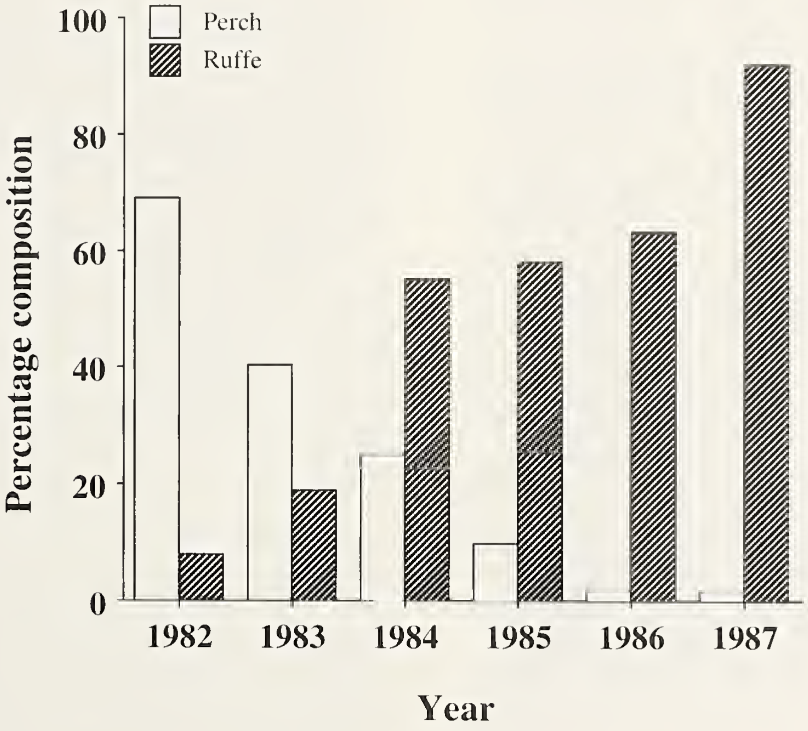


Figure 7. Percentage composition of annual catch on the water intake screens at Loch Lomond.
Data from Maitland and East, 1989.



become depleted quickly and there is therefore no sign of a fishery developing (Ian Sutherland, pers. comm.). Acidification has not affected perch in Scotland as they are distributed mainly in lowland buffered waters. Perch in Scotland have been affected favourably by eutrophication with a moderate improvement in growth and consequently increased biomass and production (Treasurer, 1990b). The possible expansion of ruffe to other catchment areas in Scotland is likely to be a potential threat to indigenous fishes. Therefore the status of ruffe in Loch Lomond should be monitored and any expansion in range studied.

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GLASGOW NATURALIST Vol. 23 part 2 p 49 (1997)

THE ROSSDHU HOUSE REINDEER ANTLERS

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It cannot be too often that a contribution to the **Glasgow Naturalist** is prompted by watching a televised golf tournament. However, during the screening of the indoor award ceremony which followed a match held on Loch Lomondside's championship golf course at Rossdhu, Dunbartonshire, I could not help but notice the fine pair of mounted reindeer *Rangifer tarandus* L. antlers displayed in the reception hall of Rossdhu House. Some 23 years ago I had the opportunity of a cursory examination of these same antlers at Rossdhu House and, as far as I was able to ascertain at the time, the history of their acquisition had never been published in a scientific journal. Reminded of the omission by unexpectedly seeing the antlers again, this belated account briefly summarises the story of their reported discovery on Loch Lomondside in 1935 (not 1937, as stated on the antlers' inscribed mount). Most of the information presented is drawn from published articles in the **Helensburgh & Gareloch Times, Lennox Herald** and **Glasgow Herald** dated 29th May, 1 June and 13 June 1935 respectively, alongside contemporary correspondence on the subject housed at Glasgow's Kelvingrove Art Gallery and Museum.

The Rossdhu reindeer antlers (Fig. 1) were described both in the press and the museum's unpublished letters as having been found in the spring of 1935 by a group of Helensburgh Rover Scouts while constructing a hut. Recent enquiry has pinpointed the site to a now dilapidated log cabin (NS 35378942) overlooking the Port o' Rossdhu Burn ravine on Luss Estates. Assumed to have been washed out of the ravine's boulder clay bank by a spate, the antlers were lodged between two rocks in the bed of the stream. Showing few signs of breakage or wear, it was concluded by those involved that the antlers had not moved any great distance from where they had lain buried and undisturbed since the last ice age. The antlers exhibit the thick-set and well palmated character of the woodland type of animal, compared with the long and slender antlers of the tundra/barren ground form. This accords with the opinion of Ritchie (1920) that the reindeer which formerly inhabited Scotland were of a forest-dwelling race.

Ironically, it is the antlers' fine state of preservation which has led to understandable doubts over their true age. In discussions with zoologists and palaeontologists, all have drawn attention to the worn and fragmented condition of most reindeer antlers unearthed in Scotland. Together with the fact that Dunbartonshire was no stranger to the 'planting' of false relics (see Munro, 1905), this may explain why, with the notable exception of the curator of natural history at Kelvingrove Museum, the scientific establishment in the mid 1930s aparently chose to ignore what could have proven to be an exceptional find. Today it would be relatively straight forward to age the antlers by radio-carbon dating, but all approaches made by the author to various institutions for undertaking or funding the project have been rejected, mainly on the grounds of the costs involved in the work. This is unfortunate, for positively dating the Rossdhu reindeer antlers would end speculation over their authenticity once and for all.

As things stand at present, there is only one piece of supplementary supporting evidence which at least points to the presence of reindeer on Loch Lomondside in a previous interglacial period. This particular find dates back to ca.1855, when a piece of reindeer antler just under 30 cms long was recovered from an excavated cutting near Croftamie, during the construction of the Forth and Clyde Junction Railway linking Stirling and Balloch. The specimen was dug out of a thick layer of glacial and lacustrine deposits, where at a depth of 5.5 m it lay just above the underlying bedrock. Confirmation of the antler fragment's identity was provided by the mid-19th century authority on animal fossils, Professor Richard Owen (Smith 1857).

ACKNOWLEDGEMENTS

Special thanks go to Sandy Kerr of Scottish Natural Heritage for providing the background information which led to the re-finding of the Port o' Rossdhu Burn site. I am also grateful to Kelvingrove Museum and Art Gallery for access to the correspondence of Dr R. Gregory Absalom, former curator of the museum's natural history department. The accompanying photograph of the Rossdhu House antlers (by courtesy of Helensburgh Public Library) has been prepared for publication by Norman Tait.

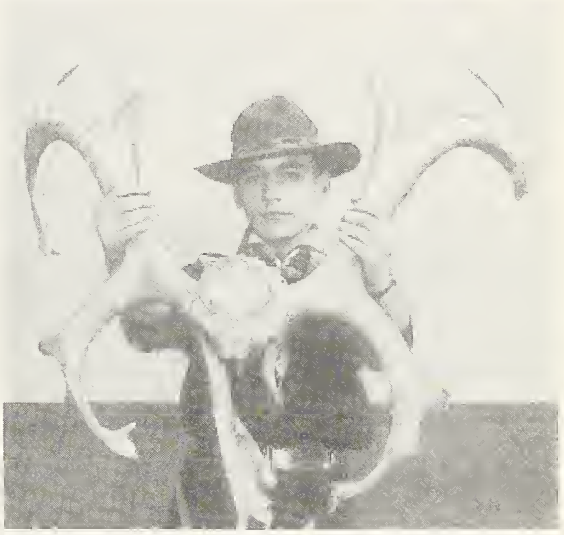

Figure 1. The Rossdhu House reindeer antlers at the time of their discovery.

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POLECATS IN THE WEST OF SCOTLAND

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INTRODUCTION

The polecat (*Mustela putorius* L.) is a carnivorous mammal of the family Mustelidae (weasels, stoats, otters, badgers and martens). Its body size, about the same as that of the introduced North American mink (M. *vison* Schreber), is intermediate between those of the pine marten (*Martes martes* (L.)) and the stoat (*Mustela erminea* L.). It occupies a variety of dry-land habitats that are distinct from the waterside niches of mink and otter *(Lutra lutra* L.) and from the mature woodland favoured by badger (*Meles meles* (L.)) and pine marten.

The polecat used to have a much wider range within the British Isles than it does at present. Severe widespread persecution is believed to have been the reason for its disappearance from most of Britain towards the end of the nineteenth century. For much of the twentieth century, the polecat appears to have been confined to Wales and the adjacent counties of Herefordshire and Shropshire (Langley & Yalden, 1977; see also map in Blandford & Walton, 1991a). Recent study has revealed a considerable expansion of its range from this stronghold into other counties of the English Midlands (Birks, 1993).

In 1987 it was noticed that polecat-like animals, superficially very similar to polecats from Wales, were frequent casualties of road traffic and gamekeeping in the western part of mainland Argyll (Strathclyde, west Scotland). This is well outside the present recorded range of the polecat in Britain. This communication compares the biometrics and colour forms of these Scottish animals with polecats from Wales.

METHODS

Between 1987 and 1995 polecats, mainly road casualties, were collected by DB in north and central Wales and by JCAC in Scotland (Figs. 1-3). All but one of the Scottish specimens in the Tables came from the mainland around the town of Oban, Argyll (national 10 x 10 km grid squares NM 80, 81, 82, 83, 90, 92, 93, NN 03). One further (male) Scottish animal from near Crieff, Tayside (grid ref: NN 8823) was almost as dark in colour as the Welsh and Oban specimens and has been included in the mainland Scottish sample. The statistical significances (P) shown in Table 1 are not affected if it is excluded. Another road casualty found in the Crieff area (NN 8023), similarly dark in colour, was not collected.

On receipt, and after drying of surplus water if necessary, bodies were weighed to the nearest g on an electronic balance. This was necessary, since intact bodies lost several tens of grams during years of frozen storage, the weight loss in eight years sometimes amounting to over 100 g per animal. Animals were frozen until side-by-side visual comparisons of all animals were made in 1995. Linear measurements were recorded to the nearest mm as described in van den Brink (1967). (Measurements but not weights were recorded from two of the Welsh animals that had been partly eaten by scavengers.)

RESULTS

Biometrics

As shown in Table 1, Welsh polecats had slightly but significantly shorter hind feet than did the mainland Scottish animals, both in males and in females. In females, but not in males, Welsh polecats were significantly shorter than mainland Scottish animals in total length, in tail length, and (not shown in Table since not measured directly) in the measure (total length minus tail length); for this measure, p was <0.05. The Welsh and mainland Scottish animals did not differ significantly in ear length or in body weight.

Colour of fur

The Scottish mainland animals differed visibly from feral ferrets (*Mustela furo* (L.)) from the neighbouring island of Islay; two Islay males examined were yellowish-buff-brown grading into brown, with no black anywhere; two Islay females examined were lighter on the head and sides than polecats but possessed the typically polecat black fore and hind legs (Plate 1). The Scottish mainland animals also differed visibly from feral ferrets from the immediately adjacent island of Mull; two Mull males examined were much paler than polecats on the head, belly, back and proximal quarter of tail.

Animals from the Scottish mainland population (Plate 1) were superficially very similar to Welsh polecats (Plate 1) in external appearance. The following differences between these two populations were noted.

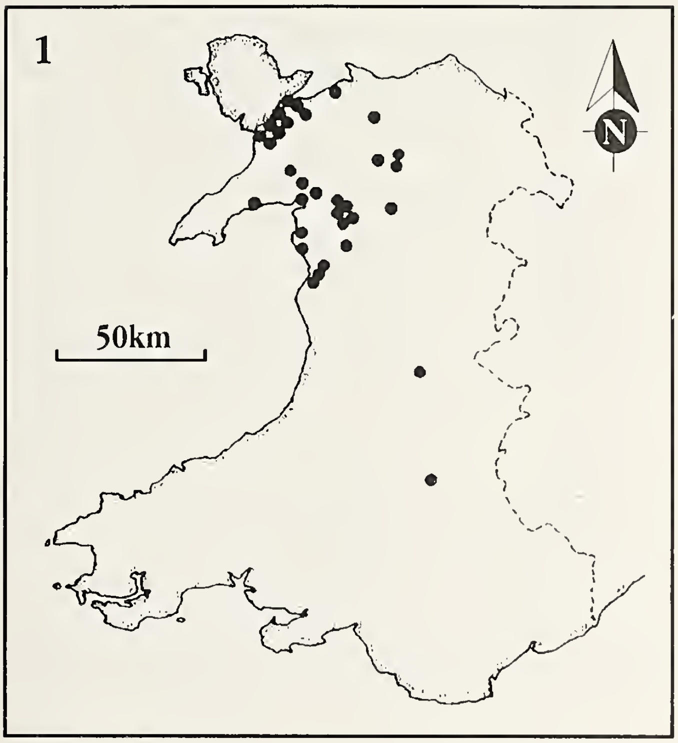
Juveniles (caught in late summer and autumn)

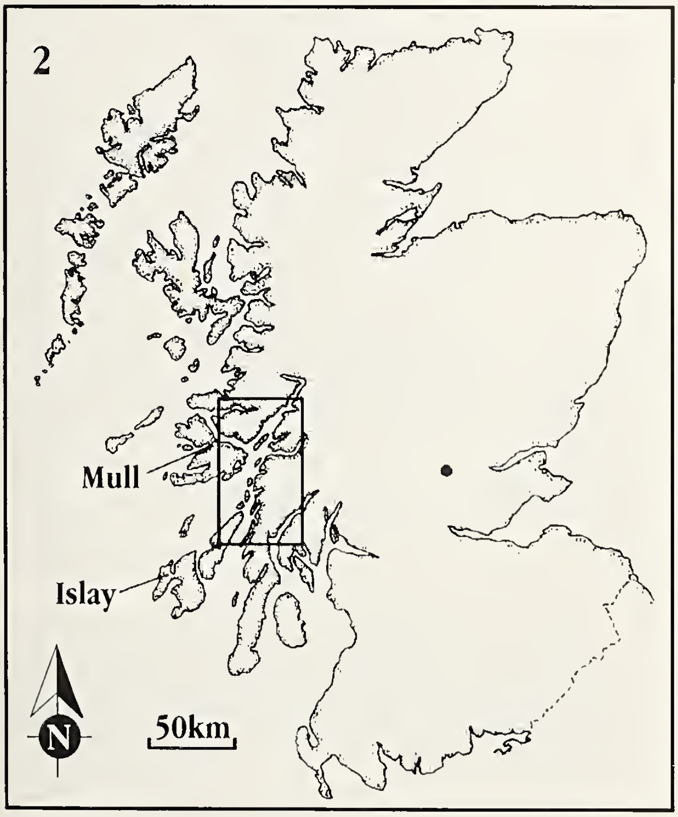
Although juveniles from the two populations resembled each other closely in general colouration and in the distribution of typically light and dark areas, they differed in one respect. The underfur of juvenile Scottish specimens showed a slight ginger-brown tinge, particularly on the side of the body between the fore and hind limbs. This tinge was absent from the whitish or whitish-grey underfur of the Welsh specimens.

All specimens

Most adults from the Scottish populations resembled those from Wales very closely. Considering animals of all ages together, abnormalities of coloration were noted in a minority of the specimens, as shown in Table 2.

Summarising the frequency of "abnormal" pale fur, 1/33 Scottish but 0/32 Welsh showed the characters of a polecat-ferret (see drawing in Blandford & Walton, 1991a). Another 4/33 Scottish but 0/32 Welsh showed gross patches more than 5 cm in maximum dimension on breast and belly. A further 8/33 Scottish and 1/32 Welsh had small (<2.5 cm long) streaks





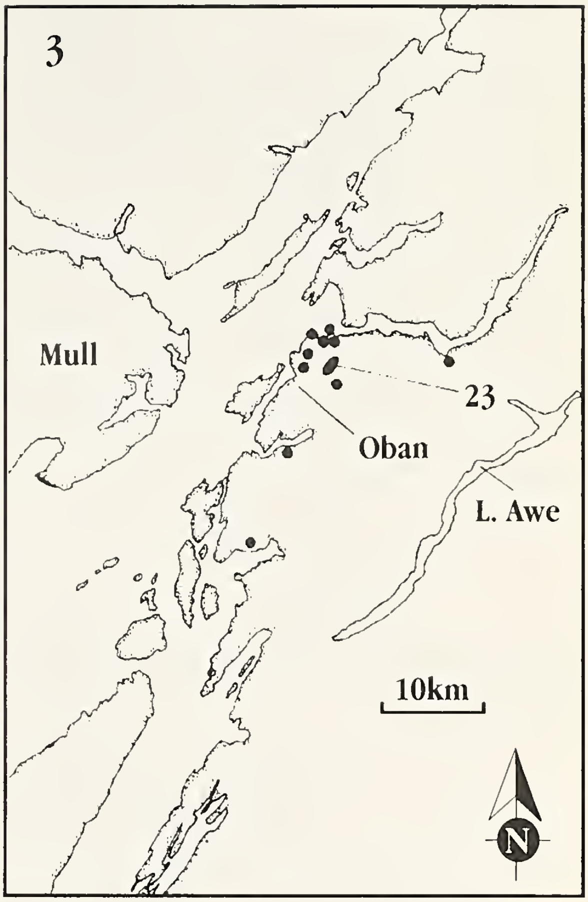


Figure 1
Map of Wales showing sites from which Welsh polecats were obtained. Each point represents one animal.

Figure 2
Map to show the parts of Scotland from which Scottish polecats were obtained. The isolated point to the east represents the single animal from near the town of Crieff (see text). The map also shows the islands of Mull and Islay, from both of which feral ferrets were obtained (see text). All the other Scottish mainland animals came from within the rectangle, which is enlarged in figure 3.

Figure 3
Map of the area around the town of Oban showing where most of the Scottish animals were obtained. 23 animals were obtained from the area shown as a small ellipse. Single animals were obtained at each solid circle. The area immediately around the south tip of Loch Awe is known to be occupied by animals very similar or identical to the animals from the Oban area. It seems likely that a single population extends between these two areas.

Table 1. Biometrics of polecats from Scottish mainland and from Wales. Means ± standard deviation. Dimensions in mm; weights in g. Measures which differed significantly between Scottish and Welsh samples are denoted by : *P<0.05, **P<0.01, ***P<0.001

	Scottish mainland	Wales
Males		
No. of animals	15	18
Total length	560 ± 22	550 ± 27
Tail length	147 ± 10	144 ± 12
Hind foot length*	60.0 ± 1.9	57.8 ± 3.1
Ear length	25.8 ± 1.1	25.7 ± 1.8
Body weight	1103 ± 182	1132 ± 279 (n=17)
Females		
No. of animals	17	14
Total length**	494 ± 8.9	472 ± 27
Tail length**	130 ± 6.9	121 ± 8.8
Hind foot length***	52.1 ± 1.8	48.9 ± 2.6
Ear length	23.3 ± 1.5	23.0 ± 1.2
Body weight	674 ± 84.5	632 ± 141 (n=13)

Table 2. Pelage characters of Scottish and Welsh polecats. Figures are numbers of animals with the characters shown. F = female; M = male.

	Polecat-ferret[1]	Gross patches[2]	Small throat patch[3]	Throat streak[4]	Total abnormal	Total normal[5]	Percent abnormal
Scottish	1F	2M 2F	2M 1F[6]	4M 3F	7M 6F	8M 12F	39
Welsh	0	0	0	1M	1M	17M 14F	3

Notes

(1) See drawing of polecat-ferret in Blandford & Walton (1991a)

(2) Whitish or pale orange patches on otherwise dark breast, belly and toes (and in three of these four animals, also on hind-knees). Breast patches typically 5 x 5 cm and continuous with whitish chin that is present in all polecats. Belly patches 5 x 0.5 cm to 14 x 5 cm, elongate along long axis of body. Toe patches 1 x 0.5 cm or less, usually only the mid-three toes on each foot, sometimes only the two outer of the mid-three toes.

(3) Small pale throat patches, about 1 x 1 cm, separate from the pale chin.

(4) Small elongate pale extension (<2.5 cm x <1 cm) to the pale chin, giving light-dark border here a ragged appearance.

(5) No abnormal light patches or streaks

(6) 1M and 1F of these are included in the 4M 3F with throat streak

continuous with, or small pale breast patches separate from, the pale chin. Thus 5/33 (15%) of the Scottish sample departed grossly, and another 8/33 (24%) of the Scottish sample and 1/32 (3%) of the Welsh sample departed slightly, from the dark polecat pattern of the majority in both groups.

DISCUSSION

The native polecat reportedly became extinct in Scotland at about the start of the twentieth century (Langley & Yalden, 1977). The origin of the thriving population of polecat-like animals in Argyll is unknown, but three possibilities can be suggested.

Firstly, it is widely believed in Argyll that an unofficial release of Welsh polecats took place south of Oban about twenty years ago. The present population may be descended from these animals. Unfortunately, details of the release have not been documented.

Secondly, polecats are secretive and difficult to detect, and they may be present unnoticed even around human habitation (Birks, *pers. comm.*) The western Highlands are a wild, poorly studied area with a very low human density and many areas where humans rarely go. Moreover, experience suggests that a majority of British people cannot distinguish not only polecat from pine marten and mink, but also these three species from stoat and weasel (*Mustela nivalis* L.). Nevertheless, records of polecats in Glencripesdale, Morvern, Argyll in 1928 (Anon., 1928) and in Ardnamurchan, Argyll, in 1947 (Batten, 1947, quoted in Langley & Yalden, 1977) are interesting, as are several records from the west Highlands in 1892 and 1893 (Beveridge, 1893) and 1903 (Bishopp, 1903; Harvie-Brown, 1903). The possibility that the polecat never became extinct in Scotland cannot be excluded.

Thirdly, the Argyll population may be an unusually dark form of feral ferret. The ferret has been regarded as a species *M. furo* that is distinct from the polecat *M. putorius*. However, the two forms interbreed and produce fertile offspring, and a range of intermediate colour forms exists. As has been suggested by Blandford & Walton (1991b), it might be more appropriate to regard them as domesticated and wild forms of a single species, much as different colour forms of the North American mink in the British Isles are now regarded (Birks & Dunstone, 1991).

The observed differences between the Welsh and mainland Scottish populations may have several explanations. The biometric differences may have arisen from sampling bias, for example by the chance inclusion of a higher proportion of younger, and therefore smaller, animals in the Welsh sample. The presence of abnormal light colour patches in 39% of the Scottish mainland individuals, compared with only 3% of the Welsh, may be because the Scottish population is descended from such a small number of animals (whether introduced Welsh or a residuum of surviving original Scottish) that they were affected by genetic drift, or by a founder effect, or by breeding with escaped ferrets.

These findings do not definitely establish the origin and relationships of the Scottish population. Further study is needed, and corpses from Scotland are valuable in this respect and should be reported or sent to the Royal Scottish Museum, Edinburgh. While these uncertainties remain, the legal status of the Scottish population remains in doubt. If they are polecats, they are protected under Schedule Six of the Wildlife and Countryside Act, 1981 (Birks, 1993); if they are polecat-ferrets or ferrets, they enjoy no such protection.

Whatever their origin, the presence in this part of Scotland of animals, most of which are indistinguishable in appearance and colour from true (Welsh) polecats, will be a matter of some satisfaction to conservationists and naturalists, although not to gamekeepers. If, as these results suggest, the Scottish animals are indeed conspecific with Welsh polecats, their presence makes Argyll one of the few areas in the British Isles where all six native species of the Mustelidae are relatively common.

ACKNOWLEDGEMENTS

We are grateful to all who supplied polecat corpses, particularly to Adrienne Stratford in Wales and Ivan Nicholson in Scotland, and to many others. Many thanks to Johnny Birks and Andrew Kitchener for making valued comments on an early draft of this paper.

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SHORT NOTES

Compiled by A.McG. Stirling

HISTORICAL

Glasgow's Neotropical Frog Connection

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Much of my research time in recent years has been devoted to the reproductive ecology of tropical frogs, mainly on expeditions to the West Indian Island of Trinidad. A species of particular interest there is *Phyllomedusa trinitatis,* a member of a treefrog genus where mating occurs in the vegetation overhanging pools and ditches, resulting in the deposition of a mass of eggs and jelly, neatly wrapped up in a leaf. Duncan Bruce and I hope to publish the results of some investigations into the control of hatching in this species. On checking the literature, we found that the earliest generally cited paper on nesting and development in the genus is by Budgett (1899), on *P. hypochondrialis.*

In 1995, it was agreed that Glasgow University's Zoology Building be re-named the Graham Kerr Building, in honour of Sir John Graham Kerr, Professor of Zoology at Glasgow from 1903-36 and at whose urgings the building was constructed. As part of an inaugural event, Margaret Reilly, Zoological curator to the Hunterian Museum, put together a historical display of Graham Kerr's work: amongst this, to my amazement, was a set of Budgett's microscope slides of *P. hypochondrialis* embryos, in beautiful condition. What's the connection?

John Graham Kerr's scientific career began when, as a 19 year old medical student at Edinburgh, he applied for and obtained the post of Naturalist on an expedition to the Pilcomayo River which drains the plain of the Gran Chaco on the borders of Argentina and Paraguay. Graham Kerr made extensive zoological and botanical collections and, on his return, switched his studies to Zoology at Cambridge. He became interested in 'missing links' in vertebrate evolution, especially lungfish, and in the links between evolution and development. During his studies, the South American lungfish *Lepidosiren* was 'found' in the Pilcomayo system he knew so well, and he resolved to return and collect eggs to study the fish's development. He did so in 1896, accompanied by his friend John Budgett, whose aim was to study the frogs of the region. Budgett's 1899 publication was one result of this collaboration.

Graham Kerr made no further fieldtrips abroad: instead, he was appointed to the Chair of Zoology in Glasgow. Budgett, however, continued the fieldwork aimed at collecting eggs of lungfish and other 'intermediates' such as *Polypterus* by making four visits to the rivers of Africa: two to the Gambia, one to the Nile, and finally to the Niger delta in 1903. This last was the most successful but, tragically, Budgett died of blackwater fever, a complication of malaria, within months of his return. It fell to Graham Kerr and his colleagues to work on the material collected by Budgett, and this is why his *Phyllomedusa* material came to Glasgow.

Two further publications on *Phyllomedusa* arose from this connection. Graham Kerr edited a Memorial Volume (1907) dedicated to Budgett, and included in it a paper by Edward Bles (1907) on frog development, based on Budgett's Chaco material, and including a description of *Phyllomedusa* embryos. Bles was then Assistant Lecturer at Glasgow and had already published (1905) the first detailed account of reproduction and development in the South African 'clawed toad' *Xenopus laevis,* later to become the frog of choice for all developmental studies.Then another Glasgow staff member, Wilfred Agar, made a further expedition to the Chaco in 1907-1908, mainly to collect more lungfish material. He was incidentally able to observe nesting in another phyllomedusine species, *P. sauvagii* and add significantly to our knowledge of reproduction in the genus (Agar, 1910). Agar's main work was on lungfish, then on parthenogenesis in the Cladocera: he became Professor of Zoology in Melbourne in 1902.

It is satisfying to see this early work followed up by Glasgow zoologists and a tradition of foreign expeditions being maintained. Fortunately for us, modern-day visits to places like Trinidad are decidedly less hazardous than those made by Budgett and Graham Kerr, and entertainingly recounted in the latter's 1950 memoirs.

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BOTANICAL

Senecio inaequidens in a Glasgow Dock

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In October 1995 a large, almost bushy *Senecio* with a woody base was seen in a cul-de-sac in the King George V Dock, Glasgow (NS53.66).

The leaves were linear and of unequal lengths. Part of the plant was taken for identification. It proved to be *Senecio inaequidens* (Narrow-leaved Ragwort) and the specimen has been deposited in the author's herbarium. The narrow leaves obviously suggested the name in English and the inequality the Latin name. This occurrence is the first record for Lanarkshire (VC 77) and probably also for the West of Scotland.

S. inaequidens is a native of South Africa and has been regarded as a wool alien, surviving or established in a few places, in particular on a sandy beach at Walmer, E. Kent and perhaps soon to spread as in north France where it is abundant (Stace, 1991; Clement and Foster, 1994).

In October 1996 there were three plants in the dock complex, all about 1/3 of the size of that seen in 1995. The local and adjoining areas will be surveyed in coming years to monitor the progress of the plant in Glasgow.

I am grateful to Mr R.M. Burton for help with identification.

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New Zealand Pigmyweed invades Glasgow

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A cut-off meander of the River Kelvin at Cadder (NS60.72) is now a hazard in the Cawder Golf Course.

While botanising in July 1996 *Crassula helmsii* (New Zealand Pigmyweed) was noted. A patch seven ft. by four ft. extended from the bank out into and over the adjacent vegetation. This is the first record for the plant for both the Glasgow area and Lanarkshire (VC 77).

Crassula helmsii is an alien species grown by aquarists and discarded into ponds and canals from which it spreads into other bodies of water. It has been available in Britain from water-garden stockists since at least 1927. It was first noticed in the wild in England in 1956, had become an established alien by 1961 and is now present there in many places. The first report in Scotland was by Kirby in 1964 from near Dunoon (Rothero and Thompson, 1994). Although colonisation has been relatively slow there are now records for about a dozen sites in Scotland (Mitchell, 1966).

I presume that the plants at Cadder have been introduced by waterfowl, although it is possible that a fragment came on a golfer's footwear. Judging by its rapid spread in England and the fact that it can smother native aquatic plants, it must be regarded as a hazard, not only to the other species in the old meander but also to those in neighbouring stretches of water. Accordingly I notified the Golf Club Manager and advised that the plant be eradicated. I took him a clump in order that he might show it to the head groundsman and the manager promised to oversee the removal of the plant. A specimen has been deposited in the author's herbarium.

When I revisited the site in mid October 1996 I saw that the plants on and close to the bank had been removed but that there was still an appreciable colony farther out. Representations will again be made and this time details will be passed on of control experiments using approved aquatic herbicides (Dawson, 1989). On both occasions I washed my boots before proceeding to record elsewhere.

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Pyramidal Bugle *(Ajuga pyramidalis)* on Colonsay (VC 102)

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Pyramidal Bugle (*Ajuga pyramidalis*) is categorised by the Botanical Society of the British Isles as a 'Scarce Plant'. In *'Scarce Plants in Britain'* (Stewart *et al.,* 1994) it is shown occurring in only two 10 x 10 km squares south of Colonsay, its main occurrence being in the north and west of Scotland. Clarke and Clarke (1991) logged it from four of their irregularly shaped recording units for the island, but up until 1995 it was only known to the author (the botanical recorder for vice-county 102) from one location, on the south west slopes of Carnan Eoin. Here it is subject to heavy grazing and usually consists of a few leaves, all flush to the ground, which are sometimes accompanied by one or two flowers, also at ground level. Wortham (author of the account of the species in Stewart *et al.*, 1994) states that reproduction is entirely by seed, and that the seed bank may be long lived. Nevertheless, continued defoliation of the upright parts of extant plants, and death of seed in the seed bank, must make the plant's future uncertain where intensive grazing occurs.

It is therefore gratifying to report that in May 1996 Miss Angela Skrimshire discovered two new locations for the plant. At the first, at Port nam Fliuchan, it is growing on a ledge on a medium-sized boulder, out of reach of sheep, but where the scope for population increase is restricted by the size of the rock. At the second, it is growing in a grassy hollow above the cliffs overlooking the Ardskenish Peninsula. Full-sized flowering spikes were formed, though these were subsequently grazed off. Nevertheless, the possibility of seed set is much greater than at Carnan Eoin. Hence overall one's perception of the possibilities for the plant's long term survival is now much improved.

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Irish Lady's Tresses *(Spiranthes romanzoffiana)* on Colonsay (VC 102)

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The number of flowering spikes of the Irish Lady's Tresses orchid that are present at any one site often varies from year to year; and the plant frequently appears at new sites, while not being evident at known locations. Records therefore need to be kept over a number of years in order to gain an accurate picture of the population size and its long term fluctuation.

In 1995 the 26 unknown locations of the orchid on Colonsay were visited, and further areas were also searched. The orchid was located at 9 sites (5 of which were new) with a mean of 2.0 spikes per site (range 1-5); at a tenth site the plant was reliably reported but the two spikes had disappeared at the time of the visit (Gulliver, 1996). Plants were allocated to former sites if they were in the vicinity of old records. Local site maps are prepared for all plants found by the author. This will allow a more precise definition of sites in the future.

In August 1996 all the sites at which the plant flowered in 1995 were examined, and other possibly suitable areas were searched. Spikes were found at 16 locations. There was a mean of 1.9 spikes per site (range 1-5), very similar to the 1995 figure. Four of the 16 sites were unenclosed (hill) land. Sheep and cattle may graze the upright parts of the plant; in addition, rabbit and invertebrate consumption may also be important (Gulliver, 1996). At one site containing 4 spikes on 12 August 1996, no spikes could be located on 29 August 1996. Flowering spikes were present on plants elsewhere on Colonsay on that date. The site which has been most regularly visited over the years was very heavily grazed in 1996, and no spikes were in evidence. The figures for this site and its environs in 1991, 1992, 1993 and 1995 were 6,1,1,3 respectively.

Three sites were visited on 20-22 September. Two plants were located, and their withered capsules collected. An initial examination suggests that they do not contain fully developed seed. 1995 and 1996 were both dry years on Colonsay, and this might explain the low average number of spikes per site for these 2 years.

It may be that colonisation of new sites and local extinction at established sites is part of the long term population biology of the species. Five new sites were found in 1995, and 4 in 1996. In order to determine whether these a) represent part of the species long term survival strategy, or b) simply reflect our current lack of knowledge of the total number of sites which exist (many of which are associated with intermittent flowering by the plant), survey work will need to be continued for several more years.

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Gulliver, R.L. (1996). The status of *Spiranthes romanzoffiana* Cham. (Orchidaceae), Irish Lady's Tresses, on Colonsay (V.C. 102) in 1995; with special reference to associated plant communities. *Watsonia* 22, 202-204.

Chenopodium polyspermum (Many-seeded Goosefoot) in a Milngavie Garden

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As I reported in a previous note (Dickson, 1996) my small vegetable garden has some unusual plants such as Field Woundwort, which has been present for over twenty-five years, and Nettle-leaved Figwort which has become weedy after being cultivated in pots by myself. Now I can report another somewhat unexpected species, Many-seeded Goosefoot. This is a species only very occasionally recorded from Scotland, though it is common in the south of Britain. In the last thirty years only two reports have been made from the Glasgow area. In the summer of 1996 I noticed several plants, from very small to large, close together in my garden. I cannot easily account for their presence, not having introduced it, certainly not intentionally. Perhaps it arrived with horse manure but that is just speculation.

Reference

Dickson, J.H. (1996). *Scrophularia peregrina* L. (Nettle-leaved Figwort) in two Milngavie gardens. *Glasgow Naturalist* 23, 57.

Vascular Plant Notes from Argyll, VC 98

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Alchemilla acutiloba (a Lady's-mantle). In May 1996, a single patch was found by a disused section of the A816 at Knipoch, south of Oban. This is the second record for Scotland, the first being on railway sidings near Bishopbriggs, Glasgow, in 1992 (Dickson *et al*., 1993).

Geum macrophyllum (Large-leaved Avens). In June 1996 this distinctive alien was found to be well established on bushy road margins at Benmore, near Dunoon, both north and south of the Younger Botanic Garden from which it presumably originated.

Hammarbya paludosa (Bog Orchid). Reference has previously been made to the elusive nature of this orchid (Thompson, 1995). On 3 September 1996, thirty-nine flowering stems were counted growing in Sphagnum close to the margin of Lochan nan Ceardach, near Kilmelford. This provided a stimulus to search for the plant elsewhere during the remainder of that month. As a result it was found in a further seven 10 km squared where it had not previously been seen by the writer. Populations were small, ranging from one to thirteen individuals and in height from ca. 20 mm to giants at nearly 150 mm. Its favoured habitat in Argyll is moderately base-rich flushes where typical associates are *Carex dioica, C. panicea, C. viridula* subsp. *oedocarpa, Eleocharis quinqueflora, Eriophorum latifolium, Pinguicula vulgaris* and *Saxifraga aizoides.*

Ornithopus perpusillus (Bird's-foot). This was first found in 1989 on the stony margin of a forest road at Ardbrecknish, near Cladich. It was subsequently found in several places, in similar habitats, in the Cladich - Dalmally area, and in some cases quite plentifully. In 1996 the plant turned up again on forest road verges near Strachur and in Glen Loin, near Arrochar. Bird's-foot is a plant of dry habitats with an essentially southern and eastern distribution in Britain. Its apparent spread in the high rainfall area of Argyll is therefore somewhat surprising. All the original sites were on well-ventilated situations in young plantations, but at Glen Loin the colony was in a clear-felled area, a potential habitat which is becoming increasingly frequent.

Luronium natans (Floating Water-plantain). In July 1995 this was found to be plentiful in all of the four lochans in the valley bottom, Glen Etive. Previously there were records from only three sites in Scotland where the plant was thought to be introduced.

Polygonum rurivagum (Cornfield Knotgrass). Growing on the recently disturbed verge of the A83 near Loch Gair (NR918897). Dr J.R. Akeroyd, who confirmed the identification, remarks that it is "... yet another Scottish site" and suspects that "... it moves around with topsoil, now an insidious form of ecological and genetic fogging..."

As part of the BSBI 'Atlas 2000' survey work, time was spent in 1996 walking sections of railway at Connel, Taynuilt, Dalmally, Glen Lochy and Rannoch Moor. In the last two places the railway provides habitats quite different from the neighbouring terrain and in the past has received little or no attention from botanists. Apart from providing a refuge for such plants as *Cytisus scoparius* (Broom), *Scrophularia nodosa* (Common Figwort), *Ulex europaeus* (Gorse), *Veronica chamaedrys* (German Speedwell), *Vicia cracca* (Tufted Vetch) and *V. sepium* (Bush Vetch), which are absent on the surrounding moorland, the railway is home to several species generally rare in Argyll: *Arenaria serpyllifolia* (Thyme-leaved Sandwort) at Connel Station, Crannach and Glen Lochy, *Cerastium diffusum* (Sea Mouse-ear) at Bridge of Orchy Station, Connel Station and Crannach, *Chaenorhinum minus* (Small Toadflax) at Connel Station, Crannach, Glen Lochy and Taynuilt Station, *Linaria repens* (Pale Toadflax) above Lochan na Bi, *L. vulgaris* (Common Toadflax) in several places, *Silene latifolia* (White Campion) in the Achallader area and *S. vulgaris* (Bladder Campion) south of Bridge of Orchy Station. The ballast species manage to persist in spite of a rolling programme of herbicide spraying of the track verges.

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ZOOLOGICAL

Terrestrial Isopod Records in Scotland

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From 30 July to 4 August 1996, three terrestrial isopod species were found in a search of five Scottish localities. Two of these are widespread enough to be considered part of Great Britain's "Famous Five" by Hopkin (1988) and consequently also have common names, the Common shiny woodlouse, *Oniscus asellus,* and the Common striped woodlouse, *Philoscia muscorum.* Both of these species were recorded from Banffshire, Scotland as early as 1877 (Smiles) by famed Scottish naturalist Thomas Edward. Present at four of the five sites was *Oniscus asellus:* on 30 July at Jedburgh (VC 80, Roxburghshire), on 2 August at Dunrobin Castle garden (VC 107, East Sutherland) and among rocks in Inverness (VC 96, East Inverness-shire), and on 4 August under rock, east bank, Kyle of Durness (VC 108, West Sutherland). These samples were evenly divided between males and females, with only one of the females (Jedburgh) carrying young. The philosciid *Philoscia muscorum* was represented by a female with young, also from Jedburgh.

In contrast to the abundance of records already in existence for these two species (1264 Scottish records for *O. asellus* and 349 Scottish records for *P. muscorum* Harding & Sutton, 1985), the third species collected, *Porcellio dilatatus,* is reported much less frequently, with only 3 Scottish records in Harding & Sutton (1985). We found specimens at two localities, the Jedburgh site and on 2 August among rocks, Skeans Dhu Hotel grounds, Altens (VC 92), South Aberdeenshire). Harding & Sutton state that the species is no doubt under-recorded and list ruins, such as those present at Jedburgh, as likely habitat. Identification of this species was facilitated by reference to the key in Sutton (1980) especially Figure 30 and the excellent drawings by Nancy Walker in Garthwaite & Lawson (1992). Volumes of *Zoological Record* published since Harding & Sutton (volumes 122-131) list no additional Scottish localities for these three species.

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Editorial Note

It is gratifying to discover American interest in the Scottish fauna. E.G. Hancock (personal communication) notes that terrestrial isopods of the Clyde area were a speciality of a Glasgow Naturalist member, Alexander Patience, in the early years of this century. Patience described several species new to science, in addition to recording the distribution of woodlice in the Clyde area. His work is recounted in Hancock, E.G. 'Alexander Patience and his work on Woodlice *(Crustacea: Isopoda)* in the Clyde Area with a list of Recorded Species *Glasgow Naturalist* 22, 133-139 (1992).

A further specimen of the fan mussel *Pinna fragilis* Pennant, from Scottish waters

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The note on *Pinna fragilis* Pennant by Zonfrillo (1996) drew my attention to the reviews of Woodward (1985, 1987) and hence to the apparent scarcity of records for this species. Therefore it would seem appropriate to place on record the details of a further specimen from Scottish waters.

There is in the collections of Inverness Museum and Art Gallery a specimen (INVMG: 1970.024) collected and donated by a Mr Gair. This was dredged by the MFV "Scalpy Isle" in August 1969, 'five miles off Duntulm in Score Bay, Sky, in 50 fathoms of water'. The dimensions are:- length 32.3 cm (taken from left valve, the tip of the right valve is missing), width 15.25 cm, thickness 5.7 cm.

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Unusual numbers of the wasp nest beetle, *Metoecus paradoxus* (L.) Coleoptera, Rhipiphoridae

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As the result of an enquiry to the museum on 10th September, 1996, Mr Kennedy of Carmunnock (NGR: 26/600571) brought in 23 specimens, 11 males and 12 females, of the beetle *Metoecus paradoxus* (L.). The beetle larva is a parasitoid of social wasps, initially feeding on the live grubs until finally devouring them and pupating within the cells of the nest. The host species in this case, *Paravespula vulgaris* (L.), was the normal one but the numbers from one nest are unusual. They had accumulated in a light fitting set into the ceiling of a room above which the nest was located. Mr Kennedy believed that it was likely that more of the beetles had been disposed of along with large numbers of wasps before it was realised that they might be of some interest.

The highest number known previously from a British nest, according to Spradbery (1973) is 24, which were from a nest in Leighton Buzzard, Bedfordshire on 27 September, 1905 (Crawshay, 1905). Apart from those given by Crowson (1981), the only other local (unpublished) occurrence that I am aware of is from the Stanley area of Paisley found on 28 August, 1992, a specimen of which is in Paisley Museum. Although the beetle is rarely seen, other data indicate that it is widespread in southern Scotland.

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Vagrant Emperor Dragonfly *(Hemianax ephippiger* (Burmeister)) at Caerlaverock, Dumfriesshire

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A male of this species was caught at Caerlaverock Wildfowl and Wetlands Trust Reserve (NY059661), Dumfriesshire (VC 72), on 3rd November, 1996. David Patterson, staff member at the reserve, saw the insect as it flew into bushes late in the afternoon, presumably to roost for the night, and was able to catch it by hand. Recognising the dragonfly as something exotic, he brought it to Tullie House Museum in Carlisle for identification. By using Askey (1988) it proved to be *Hemianax ephippiger* (Burmeister), a species which originates in Africa and the Middle East through to Pakistan. It is a noted migrant and is regularly recorded around the Mediterranean region and breeds sporadically in southern Europe. *H. ephippiger* has been reported from Britain on fewer than 20 other occasions and we believe this to be the first time it has been seen on the Scottish mainland, the only other Scottish record being from Shetland in 1970 (Silsby, 1993). There is some suggestion that this species may have become a more frequent visitor to the British Isles in recent years, another individual having been reported from the Isle of Man in 1995 (Merritt *et al.,* 1996). The Caerlaverock dragonfly was found after a period of strong southerly winds and its epic journey may well have been wind assisted.

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Odonata at Glen Moss, Kilmacolm

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Glen Moss (NS 368700 sh.63) is one of the few remaining extensive, undisturbed marshlands in Renfrewshire (VC 76). The site is situated in a hollow in the hills about a half mile due east from the centre of Kilmacolm in Inverclyde District. Glen Moss was notified as a Site of Special Scientific Interest in 1973 because of the many uncommon plants, birds and insects which thrive in this wetland area. The site is described as a mixed basin and valley mire with peat land and an area of shallow open water surrounded by sedge-dominated plant communities. Glen Moss covers an area of 20 hectares and the southern part consists of regenerating sphagnum bog with numerous bog pools in which dragonflies and other aquatic insects thrive. In 1991 the Scottish Wildlife Trust negotiated with one of the five landowners, the right to treat a large part of the site as a Nature Reserve. Two of the remaining landowners have since signed Agreement Plans and the whole of the southern area of the site is now included in the Nature Reserve.

Aerial photographs taken in 1989, when compared to earlier aerial photographs, show that the site is drying out. There has been considerable encroachment of birch and pine on the peatland areas and the open water has been reduced by an increase in the sedge-beds and rafts of begbean. The recently produced Management Plan for the reserve proposes fixed point photography over a number of years to monitor these changes. Glen Moss is slowly reverting to the drier habitat shown on the first edition OS maps published in the 1850's before the introduction of a sluice by Kilmacolm Curling Club in the 1890's for outdoor curling and skating activities. This habitat change would considerably reduce the biodiversity contained within the site. The Management Plan for the site proposes to increase the water table by reinstating the abandoned sluice.

Annual field observations have been made by the author since 1982. All the listed species have been present each year in varying numbers dependent on the prevailing summer weather conditions. The larva of most of the species listed have been found and identified and all the species have been observed pairing or egg laying over the years. It is therefore reasonable to conclude that the Odonata populations at Glen Moss are presently stable and viable colonies. The construction of suitable new bog pools, as proposed in the reserve Management Plan, should result in increasing their distribution throughout the entire site.

Eight species of Odanata breed at Glen Moss making the area a Key Site for Dragonflies in Renfrewshire. (See the Reference list for authorities on distribution and identification). The many boggy pools found in the southern part of the moss are favoured by all the species present. On a calm summer's day in July the temperatures in some sheltered corners can be very high resulting in much dragonfly activity throughout the day. The larvae of *Sympetrum danae, Aeshna juncea, Libellula quadrimaculata, Pyrrhosoma nymphula, Lestes sponsa* and *Enallagma cyathigerum* have been collected at various pools and the remaining two species *Coenagrion puella* and *Ischnura elegans* are regularly encountered.

Odonata - Zygoptera

Five species are present at Glen Moss.

Large Red Damselfly *(Pyrrhosoma nymphula)* This is the first species to emerge, sometimes as early as the end of April. It is found throughout the moss and on the heathland to the east. Pairs in tandem are regularly seen in May. Status - common. (Plate - back cover).

Common Blue Damselfly *(Enallagma cyathigerum)* Also found throughout the moss, this species is often noted as pairs in tandem flying at the edge of the larger areas of open water. Many larvae emerge on the bogbean leaves in late spring. Status - common.

Azure Damselfly *(Coenagrion puella)* Distribution maps show this species to be uncommon in Scotland but this is probably due to under-recording. At a casual glance both the Azure and the Common Blue Damselflies appear similar. A specimen has to be closely examined to discern the thoracic and abdominal characteristics which separate the two species. These distinguishing marks are easier to see on the males. Azures have only been found around the southern and eastern edge. Without a systematic approach it is impossible to give a useful indication of their distribution or status at Glen Moss. Suffice it to say that a few have been found each year. Status - uncertain.

Blue-tailed Damselfly *(Ischnura elegans)* This is another prolific species at the Moss and is found throughout the area. The female of this species is prone to colour varieties some of which have been given names. The most frequent variety occurring at the moss is ***infuscans-obsoleta*** which has no thoracic stripes and segment eight a dull brown. In July 1983 a single specimen of variety ***rufescens*** was found resting on juncus at the edge of the path at the southern edge of the moss. This variety has a bright rose-pink, unmarked thorax but retains the blue eighth segment. The specimen was not collected but photographed only. A similar individual has not been found since, despite careful searches every summer. In July 1996 a specimen of variety ***violacea*** was observed at the same location. Blue-tails are often found pairing on shrubs and grasses surrounding the moss. Status - common.

Emerald Damselfly *(Lestes sponsa)* Again, this is a prolific species which emerges all over the moss in early summer. Because of its green coloration it is very easy to overlook as it sits on a blade of grass or a rush. Emeralds have been watched and photographed emerging at a number of sites on the reserve. Mature males develop a blue pruinescence at the top (segments 1 and 2) and tail (segments 8 and 9) of the abdomen. At a casual glance they may be mistaken for *Ischnura elegans.* Status - common.

Odonata - Anisoptera

Three species are present at Glen Moss.

Four-spotted Chaser *(Libellula quadrimaculata)* During the second and third week in May, large numbers of this dragonfly may be watched emerging from larvae attached to emergent vegetation around various pools at the southern end of Glen Moss. Teneral specimens (newly emerged) drying and hardening their silvery wings are easily spotted. On a warm, calm day in June, mature adults may be seen hawking and resting. This species pairs in full flight with a great rustling of wings. The Four-spotted Chasers are a spectacular sight in June at Glen Moss. Status - common. (Plate - front cover).

Black Darter *(Sympetrum danae)* This small dragonfly emerges in large numbers in early July and specimens have been found in good condition as late as October. Again, the main concentration of individuals is at the southern edge. Pairing and egg laying activities are watched each year at various pools. A few specimens only have been seen at the north side where there is a lack of suitable breeding sites. Status - common.

Common Hawker *(Aeshna juncea)* In July, and particularly August, this large dragonfly is seen hawking around most of the reserve. In late afternoon they are often seen sunning themselves on the trunks of birch trees where they may be approached closely. Pairing adults are often disturbed from broom bushes or small birches. So far, no females have been observed laying eggs but larvae have been found in certain pools. Status - frequent.

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Reappearance of Tench *(Tinca tinca L.)* in the waters of Loch Lomond

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The waters of Loch Lomond are important as a habitat for fish. Of the fifteen native species, some are of national importance. For example, powan, *Coregonus lavaretus* (L.), of which there are only two populations in Scotland, is protected under Schedule 5 of the Wildlife and Countryside Act 1981 (Brown and Scott 1994). A population of river lampreys *(Lampetra fluviatilis* (L.)) unique in the UK in that they never leave fresh water, is also common in the catchment area (Adams, 1994).

Recent years have seen the introduction of five alien species to Loch Lomond, four of which quickly became established, and are now common in the catchment area. These are chub *(Leusiscus cephalus* (L.))., dace *(Leusiscus leusiscus* (L.)) (Adams *et al.,* 1990), gudgeon (*Gobio gobio* (L.)), and ruffe (*Gymnocephalus cernuus* (L.)). The establishment success of Crucian carp *(Carassius carassius* (L.)) is unknown as yet (Adams, 1994).

In 1870, a specimen of a tench (*Tinca tinca* (L.)) was caught near Balmaha on the south east shore of the loch (see Figure 1), having been introduced several years previously (Young 1870). This was the most recent record of the species in Loch Lomond, and it was believed that they had not become established, and that they had died out (Adams 1994). However, on the 25th of January 1997, in one of two similar flooded gravel pits connected to the main loch at Balloch on the south west extremity of the loch (Figure 1), the authors captured a single tench during a seine netting exercise. This individual (Plate 2), an adult male measuring 25.4cm (fork length), and weighing 307.1g, was estimated to be at least four years old (using size at age curves for tench presented in Maitland and Campbell (1992)).

The natural distribution of tench extends from China in the east, to the south east of England. Recently however, its range in the British Isles has been extended to Ireland and the central belt of Scotland (Maitland and Campbell 1992), probably via a human vector. A hardy species, tench are well suited to still waters with a muddy substrate and plenty of vegetation cover for predator avoidance. They are known to spend much of the winter buried in mud in a torpid condition (Jenkins 1961) (when landed, this Loch Lomond specimen was heavily coated with sediment). The diet of young tench consists mainly of zooplankton, whilst adults feed mostly on benthic invertebrates and fish eggs when available. The breeding requirements of this species are relatively restrictive in a temperate climate, because a water temperature approaching 20°C is necessary for spawning. The adhesive eggs are deposited on vegetation near the surface to which the fry remain attached until they begin foraging for food (Maitland and Campbell 1992).

The gravel pit where the fish was caught was approximately 1.2ha in area, 1.5m deep, consisting of a very fine muddy substrate supporting dense stands of reeds, and this would appear to be an ideal environment for the survival and breeding of the species. Due to the depth of the pond, a higher mean water temperature than would be found in Loch Lomond itself is likely during the summer months.

It is highly unlikely that this individual is a descendant of the original introduced population, since considerable fish sampling effort since 1950 has failed to discover tench (Adams 1994, Maitland 1994). The two gravel pits were excavated for material for the Sloy hydroelectric power station beginning in the 1940's and up until 1974 were isolated from Loch Lomond (although pike had been observed in the pits for some time before 1974 (Brian Caulfield, *pers. comm*)). Given that the oldest tench on record was 17 years of age (Maitland and Campbell 1992), there would need to have been several generations between 1870 and the 1940's (the presence of pike suggests a possible unknown invasion route prior to 1974). If this is the case, other suitable spawning grounds would have been necessary. There are at present several sites on the coast between Balmaha and Balloch, especially around the mouth of the River Endrick, which may produce similar summer conditions. It is possible that the species had succeeded in breeding at isolated sites before colonising the gravel pits, but it is more likely however, that this was a member of an isolated, more recently introduced population, or indeed, an isolated introduced individual.

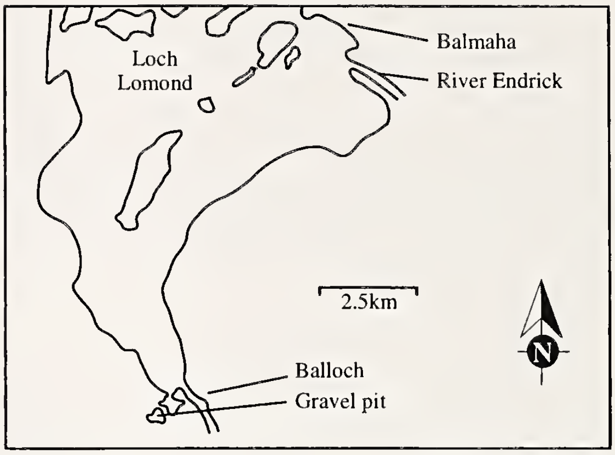

Figure 1. South Basin of Loch Lomond showing location of gravel pit

Tench may exert pressure on the native fish species due to competition. For example, competition for food with the Eurasian perch, *Perca fluviatilis* (L.) (a native species in Loch Lomond) has been demonstrated (Brünmark 1994). Although there is no evidence that tench are at present having an effect on the local fauna, nor even that there is a self sustaining population in Loch Lomond, this raises considerable concern. Despite the dangers of ecosystem changes being highlighted both in the popular and scientific literature, new fish introductions to this important waterbody may still be occurring.

The surveyed gravel pit has now been infilled for construction work, but the larger pit remains. Further seine netting at this and possibly other sites may provide additional information on the establishment success of this species.

The authors would like to thank Christopher Sanders of Crouch, Hogg, and Waterman (Civil Engineers) for the opportunity to make this work possible, and for supplying information regarding the study site. Thanks are also due to Peter Wilmott and Brian Caulfield for aid in the investigation and to Matthew O'Hare for help with seine netting.

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Tree nesting Ravens on Loch Lomondside

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Towards the end of 1995, word was received of a hitherto unknown pair of Ravens *Corvus corax* (L.) which had successfully nested earlier that year in a conifer tree on an afforested estate near the southern end of Loch Lomond. Tree nesting by Ravens is a very unusual occurrence in Central Scotland; in some 35 years of monitoring the species in Dunbartonshire and West Stirlingshire, I never once saw a nest other than on a cliff. However, the place name Kiltrochan - *coill' an troghain* or 'wood of the raven' (Johnston, 1904) - on the eastern outskirts of Balfron, suggests that Loch Lomondside Ravens did occasionally utilise trees for nesting in the past.

In company with R.H. Sewell, a visit was made to the site on 2nd May 1996, an occupied Raven's nest being found at the top of an old Scots Pine *Pinus sylvestris* L. From the birds' parental behaviour observed, the nest evidently contained young.

The colonisation of an area previously considered unsuitable for nesting Ravens because of the lack of cliffs, would appear to be part of a continuing expansion of the bird's breeding range in the lowland foothills of the region (Mitchell, 1994). Should the tree-nesting habit be adopted by this pair's offspring and their descendants, there seems no reason why the Raven could not in time join its other corvid cousins in becoming a permanent member of Glasgow's urban avifauna.

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Glasgow bird notes

Brian S. Skillen
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Birds working spoil taken in lade clearance: the old lade to the flint mill below Doune Quadrant, North Kelvinside, next to the River Kelvin, was cleared of fill and rubbish in August 1996. The material from this clearance was dumped beside the flint mill. On the morning of 14th August a range of birds were seen about what was in effect a coup. Five Rooks were working the coup and taking rubbish, including chocolate wrappers and other food materials and wrappings. Four Woodpigeons were also active on the coup and taking plant and seed materials taken in the clearance. Sparrows were also active across the site and Dunnock about the bottom of the coup taking small insects. The level of bird activity was intense and unusual for this location.

Dippers and Kingfisher on the White Cart Water: on 19th December 1995 whilst working the west bank of the White Cart Water, below the Linn Park cemetery, I saw two Dippers break cover. The birds were very noisy and excited and seemingly alarmed at my presence. One of the birds flew across the river towards me and then veered off down-stream; the other Dipper appeared to panic and became even more confused in its flight as a Kingfisher broke cover and flew off up-stream. The Dipper followed the Kingfisher briefly and, calling sharply, turned away from the flight of the Kingfisher to follow the other Dipper back down-stream. Whether or not the birds were reacting to my presence or the commotion was part of some territorial dispute is not clear but it was an unusual sighting of two types of bird common to the river.

Waxwing sightings in Glasgow in 1996: Waxwings *(Bombycilla garrulus)* were active in the city area for up to 10 weeks. Flocks of up to 100 birds were seen regularly in western districts and fed regularly on Cotoneaster about Jordanhill and Kelvindale. The birds were garrulous with a constant repeated note of "zhree-zhree-zhree" an intensity of note which allowed a small group to be located about Parsonage Row, High Street, feeding in the old High Street goods yard on 15th March. Squabbling between Starlings and Waxwings over perch sites about the north of the city accounted for noisy chattering displays from both on a number of occasions. Security of perch sites also meant that the Waxwing flocks encountered varied in their temperament; some flew off quickly, whilst others allowed an approach to within a few metres. Feeding success and the time of day may also have accounted for their variable behaviour. Daily observations of a flock stationed in Jordanhill in March showed a pattern of a perch site being used as a base from which to forage. A few birds always remained at the one site and kept up a constant chattering communication with other birds joining or leaving whilst feeding on berry-carrying bushes in local gardens. On 19th March a group of 14 birds were encountered in plantings at Kelvinbridge. The birds were feeding on surrounding berry-carrying bushes and also using the shallows of the River Kelvin to bath and drink in. The collapse of water levels with drought and weir damage allowed an 'island' of stones to form up-river of the convergence of the Pinkston Burn and it was to this that the birds flew. All members of the flock went through a noisy ritual of washing before returning to their perch. Small groups of Waxwing remained till April, departing as the berry crop was cleared about the city. Waxwings returned to Glasgow by 22 December 1996, when more than 40 birds were seen at Kelvinbridge. This is very early for Waxwings in Glasgow, and possibly a consequence of the very severe weather on mainland Europe.

Sparrow Hawk activity in Kelvingrove: Sparrow Hawks are a feature of park bird life; they use the area for perch and feeding sites when with young. In July and August 1995 this led to fighting with Magpies. I was attracted to the presence of a large female hawk on 28th July by her noisy debacle with seven Magpies. The bird launched sweeping attacks on the Magpies to try and drive them off. The fighting came down to ground level along the bank opposite the Art Galleries and immediate to the old weir. Both Magpies and Sparrow Hawk attacked continually and a Grey Squirrel which happened to be in the wrong place at the wrong time was caught briefly in one of the Sparrow Hawk's attacks between the trees. The squirrel was knocked aside and then tore off up a tree. The Magpies got the better of the hawk due to their numbers and the bird flew off towards the University. On 2nd August a young Sparrow Hawk received the same attention from Magpies but chose to stay in against the main trunk of the tree in which it was perched and held its ground during the observation. The following morning there was intense Sparrow Hawk activity and call notes suggested the presence of five birds, confirmed when they broke cover. These Sparrow Hawks again flew towards the University. Sparrow Hawks were very active during the autumn and winter months of 1995 into 1996. It was common to see birds beating along the River Kelvin at very low level looking for prey. Attacks were seen on Blue Tits at Kelvinbridge and Siskin within the park area on 17th November 1995, neither of which resulted in kills. In 1996 the perch and feeding site for young birds was close to the Old Partick Bridge. A dead tree on the 'island' below the Art Galleries was used for a perch site. Adult birds flew in along the River Kelvin or down across Gilmorehill with food. Sightings were generally early morning from late July to early August 1996 and, using tree cover, it was possible to get close to the birds. When the birds were aware of my presence they flew clear by sweeping down over the river and then up into low level overhanging branches of the trees on the west bank. This flight pattern mimics the ambush pattern by which these birds have made such an impact on parkland birdlife.

The Giant Deer or Irish Elk, *Megaloceros g. giganteus,* in Scotland

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Although subfossil remains of the giant deer or Irish elk, *Megaloceros giganteus giganteus*, have been commonly found in marl deposits beneath peat bogs in Ireland, this species had a much wider distribution in Eurasia as far as Siberia (Kitchener, 1987). However, it has rarely been recorded from Scotland, which was almost completely covered by ice during the last Ice Age and which has few areas ideal for the preservation of bone. In this note we review records of the giant deer in Scotland in chronological order of their discovery and describe a specimen previously unrecorded in the literature.

Smith (1871) reviewed giant deer finds in Scotland up to that time. The first record was in 1837 from Maybole, Ayrshire, when a complete skull and antlers were found in marl below 8-10 feet (2.4-3 metres) of peat moss in association with remains of aurochs, *Bos primigenius,* and red deer, *Cervus elaphus*. It was slightly larger than a specimen in the Royal Society, Dublin. Its current location is unknown, although it was in the possession of a Mr Kennedy of Drumellan in 1871.

In 1869 the base of a left antler with a portion of brow tine and the distal tine of an antler were found in peat 15 feet (4.5 metres) below the surface during the cutting of a railway line at Crofthead or Cowdon Glen, Renfrewshire (Smith, 1871; Gregory & Currie, 1928). These were found in association with aurochs and wild horse, *Equus ferus.* However, Bate (in Gregory & Currie, 1928) reidentified these specimens as being from red deer. They are registered in the collections of the Hunterian Museum, Glasgow (V.5193, V.5194).

A portion of the cranium (including the base of the right antler), and the beam and proximal palm of the left antler of a giant deer were found in the River Cree, Wigtownshire and donated in 1899 to the Society of Antiquaries of Scotland by Sir Herbert Maxwell (Anon., 1899). This specimen is now registered in the collections of the Department of Geology and Zoology of the National Museums of Scotland (NMS Z1993.160.012).

The fourth specimen appears not to have been previously published. It is an almost complete skull and antlers found in 1870 in peat near Kildalton Castle, south-east Islay. It was donated to the Museum of Islay Life (register no. IMT-96-001) in 1979 by Mrs M. MacGown. This specimen is in good condition; some tines are broken, including the left brow tine and the left distal tines; the right nasal bone is damaged and all teeth are missing. Measurements are given in Table 1.

There may have been other records of the giant deer in Scotland, but these may have been confused with those of the moose, *Alces alces,* of which there have been about 20 records. However, very few of these survive today, so that it is not possible to confirm their identification (Kitchener, in prep.). However, the southerly distribution and the rarity of finds of the Irish elk are consistent with those of other large cold-climate Pleistocene species (e.g. woolly mammoth, *Mammuthus primigenius*, woolly rhinoceros, *Coelodonta antiquitatis,* wild horse) and appears to coincide more or less with the southerly limit of the ice sheet covering Scotland towards the end of the Pleistocene (Kitchener, in press).

Table 1: Measurements of the skull and antlers of the Irish elk from Kildalton, Islay. All measurements in millimetres.

Length of skull	450	
Length of right antler	1260	
Length of left antler	1140	(broken tip)
Span of antlers	1950	
Basal circumference of antlers	220	(both left and right)

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BOOK REVIEWS

Compiled by RUTH DOBSON

Weather: the Ultimate Guide to the Elements

WILLIAM J. BURROUGHS, BOB CROWDER, TED ROBERTSON, ELEANOR VALLIER-TALBOT & RICHARD WHITAKER

Harper Collins, London, 1996, 288 pp., hardback with many colour illustrations. ISBN 0 00 220064 3, £14.99.

This is a remarkably comprehensive book that provides information on every imaginable aspect of weather and climate. Each of its eight chapters consists of a sequence of short, mostly two-page, articles which are densely illustrated with full colour diagrams, photographs and other pictorial material. Topics range from the factors affecting weather, through weather forecasting, to adaptations of people, plants and animals to different climatic conditions, and issues of current interest, such as ozone depletion and the greenhouse effect are also included. The last chapter, which occupies over a third of the whole book, is really a field guide to weather phenomena and has a beautiful series of photographs of different cloud types: acquire this book and you'll never again confuse a cumulus humilis with an altostratus undulatus!

The book is in general reader-friendly, with the exception of the contents page which lists chapter titles but not the topics covered in each chapter. This is a problem only because of the vagueness of some of the titles, such as 'The Nature of Weather' and 'Understanding the Weather', and topics are not even listed at the start of each chapter. However, this is not a major flaw.

This would be an excellent book for those who want a wide-ranging but not over-academic reference work on weather and climate. I fully agree with the writer of the foreword: "I can think of no better way to enjoy this book than to take it along on a picnic. Spread a blanket on the grass, lie on your back, and then name the clouds".

Iain C. Wilkie

Migration: the biology of life on the move

HUGH DINGLE

Oxford University Press, Oxford, 1996, 474 pp., paperback with many black and white illustrations. ISBN 0 19 509723 8, £25.00.

The migration of animals is one of the most fascinating of all behaviours. Our wonder at these wildlife spectacles is heightened by the fact that there is still a great deal we do not understand about how animals achieve their remarkable journeys. Hugh Dingle here attempts the heroic task of reviewing the scientific literature on migration. He includes all animal taxa, and even some plant studies, in his review. Fortunately the book is written in a highly readable style, and the author deals with the breadth and theoretical basis to his subject extremely clearly. The book is divided into four main sections. These deal firstly with the definition of migration and how this differs from other forms of movement. The mechanisms used to achieve migration are then reviewed, and this section covers the general area of how animals make their journeys. The longest section is on why animals make their journeys, and deals with the evolution and ecological basis of migratory behaviour. Finally, there is a brief chapter on the conservation significance of migration, and its significance in pest management. The book has many figures and line illustrations. It is not intended as a popular account of migration. It is, however, written in an uncomplicated style and cound be understood by anyone with a serious interest in knowing more about the biological basis to migration.

David C. Houston

The Natural History of Pollination

MICHAEL PROCTOR, PETER YEO & ANDREW LACK

Harper Collins, London, 1996, 479 pp., softback with 8 colour plates and over 250 black and white photographs and drawings. ISBN 000 219906 8, £16.99.

In 1973 Michael Proctor and Peter Yeo published their New Naturalist volume *The Pollination of Flowers.* In the present publication they have been joined by Andrew Lack who is specially interested in the work done since then in the fields of Ecology and Evolution.

The new book differs from its predecessor by showing a notable shift in emphasis towards a more functional view of the benefits and costs of the pollination relationship to flowers and their visitors and the ways in which these interact, and in the recognition of the expansion in research on pollination in Europe and on the Mediterranean coast, in America, Africa and further afield and how this is related to pollination in Britain. Further, the enhanced international travel facilities now available and a greater awareness of the world's flora and fauna, largely due to television and its range of natural history films, both contribute to a huge resurgence of interest.

This book is, as the authors write "a selective distillation of a vast subject" and, with its substantial and well-illustrated text, it cannot fail to provide a rich source of study. The authors express the hope that it gives a reasonably rounded view of pollination biology in the 1990s and modestly hope that it will give pleasure and interest to many readers. So do we all!

Frank Robertson

The Seashore of Britain and Northern Europe (Collins Pocket Guide)

PETER HAYWARD, TONY NELSON-SMITH & CHRIS SHIELDS

Harper Collins, London, 1996, 352 pp., softback with over 3000 species described and illustrated in colour. ISBN 0 00219955 6, £12.99.

The title of this guide may be misleading as it not only covers the shores of Britain and Northern Europe but also describes many species found in the Mediterranean. It offers an easy to follow key to the species of plants and animals most likely to be encountered by the amateur naturalist as well as those with a degree of biological knowledge. There is an interesting, if brief, introduction to the physical conditions found in the geographical area covered although a little more detail on species distribution on the shore would have been useful. Each species described is also illustrated in colour and common names given where possible but a level of anatomical knowledge of many species is assumed in the text. The note on conservation, aimed at reducing collection is welcome but with many species only identifiable to species level by subtle anatomical characteristics, it is unrealistic to hope, as the authors do, that most can be identified in the field, even with a guide as good as this one undoubtedly is. In addition, much of the microfauna such as Copepods, Ostracods and Isopods require a laboratory and a microscope as those of us who have visited the University Marine Biology Field Station at Millport will testify. In conclusion this book lives up to its claim to be a comprehensive guide to the plants and animals found on the seashore and with a price of only £12.99, I would certainly recommend it to anyone with a love of nature who enjoys a walk along the seashore.

Andrew Kelly

How to Identify Edible Mushrooms

P. HARDING, T. LYON & G. TOMBLIN

Harper Collins, London, 1996, 192 pp., softback with numerous colour illustrations. ISBN 0 00 219984 X, £9.99.

The publishers claim that this is the first book to describe and illustrate all the edible species of mushroom (mushroom and toadstool being treated as synonyms). Presumably the claim only applies to those likely to be found in Britain, although this is not made clear. However, the edibility of some less common British species is not known and so in a sense the claim is an exaggeration. The publishers also claim that the book is suitable for those entirely new to the subject, but they and the authors cover themselves against the consequences of any misidentification by printing on an early page, in small print, that they do not accept responsibility for any identification of any mushroom made by users of the guide. A good general rule for anyone wishing to collect and eat wild mushrooms is to learn to recognise the poisonous species first before collecting for the pot, and the section on poisons and poisoning in the 'Introduction' should be enough to reinforce this rule. Certainly, any one entirely new to the subject would be well advised to get an experienced mycologist to confirm the identification of any collection before attempting consumption and not go it alone from the beginning. Having said that, the lay out of the book should reduce the chance of even the relatively inexperienced making a mistake. This is because each of the 50 or so species considered worth eating is listed and compared with all the 'lookalikes' with which it may be confused. The 'lookalikes' include all poisonous species together with other edible species and any which, while not poisonous, are just too inedible to be worth bothering with. Another feature which should reduce the possibility of error is the listing of the edible species according to the habitat in which they are commonly found, grassland, broadleaved woodland and coniferous woodland. As a very sensible precaution some edible species, e.g. *Amanita rubescens,* are deliberately listed as poisonous because the authors consider that they are too easily confused by beginners with deadly poisonous species. Each species is illustrated, although the illustrations are not the best feature of the book; some representations are not very typical and users would be as well to compare specimens with the illustrations in other identification manuals, particularly those by Phillips, Jordan, or Pegler and Spooner, all of which are illustrated with excellent photographs. The book offers good advice and if used carefully, and initially with help, should be a useful addition to the adventurous gourmet's bookshelf.

D. Clarke

The Fern Guide: a field guide to the ferns, clubmosses, quillworts and horsetails of the British Isles

JAMES MERRYWEATHER & MICHAEL HILL

Field Studies Council Publications, Shrewsbury, Second edition, 1995, 188pp., softback with coloured photographs, line drawings and maps of each species. ISBN 1 85153 211 0, £6.00.

The usefulness of this publication is indeed that indicated by the sub-title, namely that it is an Introductory Guide to the Ferns, Clubmosses, Quillworts and Horsetails of the British Isles. The more common alien species are also included. The fern life-cycle is described in the introduction. There follows a checklist of the pteridophytes of the British Isles and a well illustrated glossary of pteridological terms. Major keys lead to the family groups with subsequent keys giving the identification features within the family. In each case there is an outline illustration and a detailed drawing of the important diagnostic features. An inset is provided giving the dot map distribution of each species. It does not give the *Dryopteris affinis* subspecies but is otherwise comprehensive. There are 30 colour plates which are visually attractive but do not add, to any appreciable extent, to the diagnostic value of the book. I have used the *Guide* throughout the 1996 season and found that it works in practice. The book is attractively presented and can certainly be recommended as a fern guide.

P. Macpherson

Alien Grasses of the British Isles

T.B. RYVES, E.J. CLEMENT & M.C. FOSTER

Botanical Society of the British Isles, London, 1996, 181 pp., softback with numerous line drawings. ISBN 0 901158 27 5, £10.50.

This is a companion book to *Alien Plants of the British Isles* reviewed in the last issue of the *Glasgow Naturalist* (volume 23, part 1, page 65). On this occasion the authors have given details, not only of all the alien grasses known to have been recorded in the British Isles, but also information regarding potential grass aliens. There is also special indication of the plants which are of particular economic importance.

The catalogue gives information on 580 non-native grasses, plus about 50 taxa which occur both as native and of alien origin and a further 80 potential or overlooked species. I am surprised to learn that they consider that only 60 alien grasses have become established. The major sources are described in some detail. These include imported grain, ballast, wool, bird-seed and hortal introductions.

The publication is much more than a checklist, aiming also to be an aid to identification. Keys have been devised for some of the larger and more difficult genera. There are over 100 illustrations showing not only the whole plant but also magnified views of diagnostic features. As with the previous book, the catalogue section gives accounts of plants in the following sequence: scientific name, name in English, frequency, status, mode of introduction, origin, location of voucher specimens, references and synonyms.

The authors are to be congratulated on their considerable effort over many years in amassing and categorising all the available information on the subject. The book is well presented, reasonably priced and is strongly recommended.

P. Macpherson

Pondweeds of Great Britain and Ireland (BSBI Handbook No. 8)

C.D. PRESTON (illustrated by L.T. ELLIS)

Botanical Society of the British Isles, London, 1995, 352 pp., softback with numerous line drawings. ISBN 0 901158 24 0, £16.50.

Since the time of J. Dandy and Sir George Taylor some half century ago, there has been, until recently, little serious work on the British Potamogetonaceae, and it has been a continuing disappointment to British botanists that these authorities never produced a comprehensive account of our native pondweeds based on their extensive researches. The production of such a work by the present author is therefore particularly welcome. This handbook is the result of more than ten years study and fieldwork by C.D. Preston of the Institute of Terrestrial Ecology, and the illustrations are mainly the work of L.T. Ellis. More than one third of the book is devoted to detailed accounts of the classification, morphology, ecology and distribution of the Potamogetonaceae. The two species of *Ruppia* (Tasselweeds), a closely related genus, are also included, although opinions differ as to whether it should constitute a separate family - the Ruppiaceae. These introductory sections are followed by notes on the collection and preservation of material, notes on the distribution maps, and a 16-page key to the species. The remainder of the handbook is mainly occupied by detailed descriptions of the species and their numerous hybrids each, with the exception of a few of the rarer hybrids, being accompanied by a map showing its British distribution, distinction being shown between pre- and post-1970 records. Finally there is a very comprehensive guide to the relevant literature, a glossary of terms used, and an index to both the common and scientific names.

This thoroughly researched and professionally produced work should be in the hands of all those interested in the pondweeds. It is difficult to identify any aspect of the genus or its biology which has not been expertly covered in this long-awaited handbook. The finely executed line drawings are particularly appreciated as accurate illustrations of many of the species and hybrids have been lacking hitherto. This has been especially true of the 'grass-leaved' species.

The author and his illustrators deserve the congratulations of both professional and amateur botanists for producing this handbook which is one of the best examples of its kind.

A. McG. Stirling

Wild Flowers of Britain and Northern Europe (Collins Pocket Guide)

R. FITTER, A. FITTER & M. BLAMEY

Harper Collins, London, 1996, 352 pp., softback with numerous colour illustrations. ISBN 0 00 220062 7, £9.99.

First published in 1974, this is a new edition of one of the more popular illustrated field guides. Covering the British Isles and much of north-west Europe, the new edition includes over 1450 plants illustrated in colour, with nearly 2000 species described. It has been up-dated, to incorporate name changes, and a welcome improvement is that illustrations and text now appear on facing pages. However the book is still largely based on the first publication, following the same format and layout, with many of the original illustrations. The text remains concise but with much information, although the highlighting of diagnostic features would have been helpful. There is a glossary and additional text on aliens and microspecies to the back of book, with again useful, but very concise text on plant ecology.

The layout of the initial colour keys based on flowers is a good visual aid, although the colours are a bit strong, and the user may still be left having to check the main text for a number of likely candidates. There are some keys to the larger families, but many other families require the scanning of illustrations or text to confirm the identification of a particular specimen. Although such keys are practical and designed for easy use, I personally prefer the use of more systematic ones which enable the user to develop an understanding of family features. This can be of help when encountering an unusual plant or indeed an alien species. The book's cover of alien species is not extensive, particularly for users with a largely urban flora, such as about Glasgow.

The book is compact but full of information, and is very well illustrated. At under £10, for anyone wanting to develop a good knowledge of the British flora, the book represents good value for money.

Keith Watson

Wild Flowers (Mitchell Beazley Pocket Guide)

PETER MOORE

Mitchell Beazley, London, Revised Edition 1996, 191 pp., hardback with colour illustrations. ISBN 1 85732 773 X, £7.99.

This truly pocket-sized flower book has proved its popularity by the fact that it has been reprinted 10 times since 1980. This revised edition has been necessary in order to update the naming to those used in "The New Flora of the British Isles" (Clive Stace CUP, 1991). There is a simplified key to families, which, like all simple keys, does not always work. The reader is then directed to the appropriate family, but there are no further keys. Over a thousand species are described and illustrated, along with habitat symbols, and abbreviations for distribution. There is a remarkable amount of information in such a small space and the book could be useful as a quick reminder of differences between related species. However I am not sure how easy it would be for a complete beginner, as some of the illustrations do not give the feel of the plant and a more experienced botanist would be puzzled by the order both of the families and the species within each family.

Jean M. Millar

Alan Mitchell's Trees of Britain

ALAN MITCHELL

Harper Collins, London, 1996, 368 pp., hardback with black and white photographs and 8 colour plates. ISBN 0 00 219972 6, £14.99.

The late Alan Mitchell was a renowned expert on trees and tree growth. For many years he made many girth measurements and wrote copious notes on trees, native and exotic, planted throughout Britain and Ireland. He was an engaging correspondent as the reviewer well knows and this book is written in a very readable style. It is not intended as an identification guide; there is already his Collins Field Guide. This book discusses the geographical origins of the alien trees and gives the locations, dates of first plantings as well as the girths and heights of the biggest specimens of over 150 species of tree in all, both coniferous and broad-leaved. There are eight colour plates and a black and white photograph of most of the species described. Ireland is often referred to despite the title being restricted to Britain.

J.H. Dickson

Trees (Mitchell Beazley Pocket Guide)

KEITH RUSHFORTH

Mitchell Beazley, London, 1996, 192 pp., hardback with colour illustrations. ISBN 1 85732 7713, £7.99.

A newly revised edition in the same format as the other titles in this genuinely pocket-sized series. Profusely illustrated to a generally good standard, although the colour reproduction is a little suspect at times. Included are a large number of 'exotics' which are commonly grown in Britain, making this book an ideal companion for the urban tree lover with ready access to Glasgow's many parks and gardens. I really must get to see the broad-leaved cultivar of himalayan whitebeam which bears my name!

John Mitchell

Caseless Caddis Larvae of the British Isles: a key with ecological notes

J.M. EDINGTON & A.G. HILDREW

Freshwater Biological Association, Ambleside, Scientific Publication No 53, 1995, 134 pp., with black and white plates and many figures. ISBN 0 900386 55X, £14 including p/p 2nd class U.K. and printed paper rate overseas.

British Freshwater Megaloptera and Neuroptera: a key with ecological notes

J.M. ELLIOTT

Freshwater Biological Association, Ambleside, Scientific Publication No 54, 1995, 68 pp., with black and white plates and many figures. ISBN 0 900386 56 8, £8 including p/p 2nd class U.K. and printed paper rate overseas.

Two more useful keys for the identification of aquatic life have appeared from the stable of the Freshwater Biological Association. The caddis flies treated are those that do not construct and occupy the familiar portable cases. Instead they may be net spinners or free living predators and number 46 species found in 6 different families. The ecological information on each species is extensive and the bulk of the text is devoted to details such as taxonomic notes, providing supplementary information to the keys, and much detail on life cycles, general biology, behaviour and habitat preferences. In the expectation that cased caddis will often be collected and become disassociated from their homes, the keys provide 'get out clauses' to avoid any possibility of confusion. Caddis are a considerable element of the aquatic food web, providing food for fish and other organisms, and so we humans regard them as of economic importance linked to water quality and food resources. A clue to this is provided in the sponsorship of this revised second edition by the National Rivers Authority. Caddis are of course fascinating in their own right and fair game for the amateur naturalist too.

The second booklet, on the relatively popular alder flies and lacewings, is a new and considerably revised edition, the last issue of which was in 1977. Even with those whose life cycle is semi-aquatic there are only 7 species to consider but the keys include non-aquatic ones sufficient to prevent confusion. Larvae are keyed separately with the exception of one rare species whose juvenile stages are unknown. The style of presentation is different from the caddis key in that it has all further information under each species - clearly linked to the smaller numbers involved. I still find it rather frustrating that distributional information is not provided for the British Isles for each species in this key, or in a number of the other publications in this series. The caddis key referred to above is exceptional in this respect. Although it is not the function of FBA to produce maps as such, the amount of detail that is provided, far beyond the requirments of most ordinary aids to identification, would have been enhanced even further with a simple statement on geographical extent for each species. This is probably a conscious decision. Such information can often become redundant remarkably quickly (if too detailed) and it should never form part of the key characters for distinguishing species. It seems almost churlish to cavil on this issue and it would have been an even thicker layer of icing on the cake. All the publications in this series provide unique and invaluable aids to the study of freshwater biota.

E.G. Hancock

Natural History and Evolution of Paper-Wasps

STEFANO TURILLAZZI & MARY JANE WEST-EBERHARD (Editors)

Oxford University Press, Oxford, 1996, 400 pp., hardback with black and white photographs, many line drawings, tables and graphs. ISBN 0 19 854947 4, £65.00.

The Paper-Wasps form a distinct group of social Hymenoptera which, though related to familiar genera such as *Vespula*, differ in that they form only small colonies, their nests are open with relatively few cells and their queens and workers are closely similar. Although not present in Britain, Paper-Wasps have an almost world-wide distribution with the best-known genus, *Polistes* having 203 species.

Their small, exposed and easily-observed colonies make these insects ideal subjects for observational and theoretical studies of the origins and evolution of social insects and they have been studied extensively during the past 50 or so years. Life-histories differ, but examples of monogyny, polygyny, social parasitism, usurpation, cooperation, aggression and submission all occur and provide ample material for discussions on considerations such as altruism, kin selection and inclusive fitness.

These and many other topics, including, phylogeny, biogeography, ecology, learning, courtship, homing, exocrine glands, cuticular hydrocarbons, kin recognition and the evolution of insect societies in relation to nest design are considered in the present volume which arose out of an international workshop entitled "Natural History and Evolution of an Animal Society: The Paper-Wasp Case" held in Italy in 1993.

The 18 chapters, contributed by 23 specialists on social insects (one posthumously) and one scientific philosopher, mostly take the form of critical reviews with suggestions for the future. Some, however, contain new data. Several articles appear in translation but this is not apparent in the finished text which, though highly technical and heavy going at times, is impeccably written.

The text is supported by an extensive bibliography (1013 references) and an index. Some chapters have concluding remarks but, regrettably, none have summaries.

Ronald M. Dobson

The Lepidoptera: Form, Function and Diversity

MALCOLM J. SCOBLE

The Natural History Museum in association with Oxford University Press, 1995, 404 pp., softback with 4 colour plates, numerous black and white photographs and line drawings. ISBN 0 19 854952 0, £25.

This book is a reprint, with corrections, of the 1992 first impression and will be welcomed by all serious students of Lepidoptera.

It is divided into three parts. Part 1 is concerned with structure and function and topics such as adaptations of the proboscis to different foods; wings, scales, flight and migration, colour and pattern, abdominal glands and genitalia are considered in depth. Sections on the immature stages and their significance and on the senses, particularly those of hearing, sound and scent follow. The uses of hearing and sound in defence against bats are particularly stressed. Part 2 is brief and deals with the environmental and ecological importance of Lepidoptera and discusses them in relation to food plants, parasitoids, higher animals (including man) and as indicators of environmental conditions. Part 3, almost half of the book, deals with the characteristics, interrelationships and biology of superfamilies and families in systematic order. An extended bibliography of 768 references concludes the volume.

The book is authoritative, pleasingly produced and well illustrated; very few errors were noted. It should remain the definitive work on the group for many years.

Ronald M. Dobson

Butterflies (Mitchell Beazley Pocket Guide)

PAUL WHALLEY & RICHARD LEWINGTON

Mitchell Beazley, London, 1996, 168 pp., hardback with many colour illustrations. ISBN 185732 7721, £7.99.

As the name implies, this is a handy-sized book which can be easily slipped into a pocket. It is an up-dated version of a book first published in 1981 and gives information on over 360 species of butterflies from all over Europe. It is certainly up to date, including species such as the Geranium bronze, which has only recently been introduced to Europe from South Africa. It is superbly illustrated throughout with Richard Lewington's very accurate art work, based mainly on specimens from the Natural History Museum. Relevant features for identification are noted beside the illustrations, which are helpful in distinguishing similar species. General information is given for each butterfly, together with its general distribution within Europe. The distributions given are rather vague, however, and the inclusion of distribution maps would have been useful. A series of symbols gives habitat information, indicates if the species occurs in the British Isles and if it is protected by law in some countries. This is, however, very misleading. For example only a few of the 25 species listed under the British Wildlife and Countryside Act are marked as protected, but the Camberwell Beauty (a rare migrant to Britain) is marked as occurring in the British Isles and as protected (presumably elsewhere in Europe).

On the whole I found this a well laid-out, easy to use guide to European butterflies. I would not recommend it as a field guide for use in Britain, as there are better books available, but when travelling around the rest of Europe it could be a useful thing to have in your pocket!.

Richard Sutcliffe

Wild Animals (Collins Gem Photoguide)

JOHN A. BURTON

Harper Collins, London, 1996, 256 pp., paperback with numerous colour photographs. ISBN 0 00470824 5, £3.99.

As an introduction to European mammals, reptiles and amphibians this is a handy little book. The text is informative and deals with over 220 species, giving a description for each and detailing size, habitat, food and range. Habitats throughout Europe are described and there is a section on conservation. Unfortunately, some photographs are not clear and leave one wondering what the individual species actually looks like.

Joyce Alexander

Snakes (Collins Gem Photoguide)

CHRIS MATTISON

Harper Collins, 1996, 256 pp., paperback with numerous colour photographs. ISBN 0 00470825 3, £3.50.

Snakes are grouped into 15 families and this book deals with at least one representative from each family. It has 16 pages of fascinating introductory information which includes feeding, senses and defence. The photographs are good and information on size, distribution, habitat, food and breeding habits is given for each of the 220 species along with a descriptive passage for each one.

Joyce Alexander

Garden Birds (Mitchell Beazley Pocket Guide)

DOMINIC COUZENS & MIKE LANGMAN

Mitchell Beazley, London, 1996, 160 pp., hardback with numerous colour illustrations. ISBN 1 85732 495 1, £7.99.

This new and compact pocket guide excellently meets its designed target (beginners) and can delight those already familiar with birds that visit British gardens. It concisely and cleverly describes the appearance of over 80 species, each in a two-page spread, and others with which they might be confused. The many delightful colour illustrations also cleverly convey aspects of movement-behaviour ("jizz") as well as the plumage of immature forms. Perhaps the white heads of gulls are too heavily shaded and the greenfinches too uniformly green (summer males are even brighter but young and females may look dully brown) but the illustrations are generally crisp and accurate. Concise comments are given on features such as 'where found', 'identification', 'feeding', 'voice', 'nest', 'young', and 'garden tips' on attracting birds. At less than £8 this is a good buy!

Norman Grist

Garden Birds of Britain and Europe (Collins Nature Guide)

DETLEF SINGER

(Translated and adapted by IAN DAWSON)

Harper Collins, London, 1996, 155 pp., softback with numerous colour plates. ISBN 0 00 220056 2, £6.99.

This pocket-sized handbook from Collins covers a wide range of species in both Britain and Europe and should be particularly useful to travellers on the Continent as some of the species described are seldom seen in Britain - perhaps because our gardens are insufficiently enticing! The book has a wealth of excellent clear photographs with colour-coded aids to identification and small photographs of nests and eggs as a helpful extra. The concluding pages supply various ideas for helping birds in our gardens and what to do with lost baby birds.

Jane Christie

Hamlyn Birdwatching Guides

Where to Watch Birds in Spain and Portugal

LAURENCE ROSE

Hamlyn, London (in association with Bird Life International), 1995, 214 pp., softback with 8 colour plates, maps and line drawings. ISBN 0 600 58404 6, £14.99.

Where to Watch Birds in Scandinavia

GUSTAF AULEN

Hamlyn, London (in association with Bird Life International), 1996, 216 pp., softback with 8 colour plates, maps and line drawings. ISBN 0 600 58459 3, £16.99.

Where to Watch Birds in Turkey, Greece and Cyprus

HILARY WELCH, LAURENCE ROSE, DEREK MOORE, BILL ODDIE & HARRY SIGG

Hamlyn, London (in association with Bird Life International), 1996, 216 pp., softback with 8 colour plates, maps and line drawings. ISBN 0 600 58232 9, £16.99.

These three books are all produced in the same format. Scandinavia deals with Denmark, Finland, Iceland, Norway and Sweden but not the Faroe Islands: Turkey, Greece and Cyprus also covers several Greek islands, including Crete and Corfu but not Rhodes: Spain and Portugal includes Balearic and Canary Islands, Madeira and Azores.

For each country the introduction gives a map showing the location of sites described, very useful general information about the country, the bird habitats present and their importance for birds, the seasonal changes in birds present, information about travel to and within the country, remarks about conservation there and, for some, the address and details of the countries' ornithological societies

The descriptions of sites include a note of the habitat, the best time to go and the interesting species to be seen. Details of access are given and, for about a quarter of sites a clear detailed sketch map which gives locations of specialities present. The books are illustrated by line drawings of birds in the text and eight pages of excellent full colour artwork plates featuring eighty birds typical of the region.These books, containing a mine of necessary and useful information at a reasonable price, would be invaluable for a birdwatching visit to any of these countries. Although rather heavy to carry, they could be highly recommended.

Ruth H. Dobson

Top Birding Spots in Britain and Ireland

DAVID TIPLING

Harper Collins, London, 1996, 320 pp., softback with numerous coloured photographs and maps. ISBN 0 00 220035 X, £9.99.

This pocket sized guide has an attractive layout with coloured maps and descriptions of locations. The text, in addition to listing birds to be seen at different times, gives details of disabled access and information of a more general nature such as botanical, geological and historic interest for the non birdwatching members of the family. One advantage of the book in being recently published is that access information should be up-to-date. There is a section on Scotland with a location map. As the book states that all RSPB reserves are covered I was surprised to note a dearth of reserves on the map in the Glasgow area. On further inspection of the book I found a section entitled' Additional Scottish Sites' which listed and gave details of a further 34 sites, although no apparent mention of the new Mersehead RSPB reserve.

In conclusion I consider the publication to be a good buy at £9.99.

Ian C. McCallum

Birds of Eastern Africa (Collins Illustrated Checklist)

BER VAN PERLO

Harper Collins, London, 1995, 300 pp., softback with coloured illustrations. ISBN 0 00 219937 8, £14.99.

To attempt to produce a single, compact field guide to all of the 1487 species of birds of East Africa is a remarkable undertaking. The old two volume set of Mackworth-Praed and Grant failed to achieve this coverage in over 2000 pages. The present volume covers Kenya, Tanzania, Uganda, Ethiopia and Somalia, but not Zambia, Malawi, Zimbabwe and Mozambique. It includes a distribution map for each species, together with a full colour illustration. It is an outstanding achievement for one author/artist. The problems of the book lie in its complete coverage. The illustrations are remarkably good, even by the high standard of modern bird artists, but the need to include so many species in each plate inevitably makes them rather cramped and uniform in style. Text on each species is confined to two or three lines, which limits the amount of useful information it can include. Someone not familiar with the birds of the region is likely to become overwhelmed by the contents, and would feel far happier with the Collins Williams and Arlott Field Guide, which deals with less than half as many species but includes only the common birds and is able to give each a more useful description. The specialist is equally likely to be dissatisfied - I doubt that anyone could confidently identify in the field most nightjars or cisticolas from this book (or any other fieldguide come to that) and would be looking for a far more authoritative treatment. But it would be a useful pocket book for the really serious birder who already knows the common birds of the region. I fear it could put a beginner off birdwatching for life.

David C. Houston

An atlas of seabird distribution in north-west European waters

C.J. STONE, A. WEBB, C. BARTON, N. RATCLIFFE, T.C. REED, M.L. TASKER, C.J. CAMPHUYSEN & M.W. PIENKOWSKI

J.N.C.C., Peterborough, 1995, 326 pp., softback with numerous distribution maps, graphs and tables. ISBN 1 873701 94 2, £28.

This is essentially a technical manual of the distribution of all seabirds in our surrounding waters, including the extreme rarities. It is for species such as Gannets, Skuas and Auks that UK is most responsible, harbouring significant breeding or wintering populations. Having an atlas of distribution showing exactly where seabirds are at sea is an enormously useful tool in dealing with present and future threats to seabird populations in their feeding as well as breeding areas. Oil pollution, over-fishing, pesticides and other chemicals affecting the marine ecosystem can be linked to areas of seemingly featureless ocean over which seabirds are regularly concentrated. Rapid responses can be enacted when disasters occur and it is to data such as this that conservationists will first turn and base their efforts. The authors and fieldworkers are to be applauded for what is the completion of an enormous task. For those with an interest in seabirds or other forms of marine biology this is essential reading.

On reflection, the makers of sea-sickness pills should have sponsored this publication as I am sure vast quantities must have been consumed during the years of surveying seabirds on the high seas!

Bernard Zonfrillo

The Roe Deer - Conservation of a Native Species

RICHARD PRIOR

Swan Hill Press, Shrewsbury, 1995, 230 pp., hardback with coloured and black and white photographs. ISBN 1 85310 532 5, £45.00.

This comprehensive publication by a world expert on roe deer covers the biology, reproduction and behaviour of this beautiful animal. Most wildlife in the countryside is sadly reducing in numbers; however, the roe deer has successfully succeeded in recolonising most of the country in spite of causing considerable damage to crops.

The text is very readable and illustrates management techniques to provide good habitat and criticises planting thick vegetation adjacent to roads which can cause accidents resulting in deer fatalities, to say nothing of human injuries and the cost of car repairs. The author also relates an incident of tourists travelling from Newcastle Airport to Mallorca who where, much to their surprise, landed at Luton Airport to check for possible damage, as the Boeing 737 had collided with a roe on taking off from Newcastle. The author has travelled extensively in his researches and his accounts of roe in Russia are of interest where roe are subject to control by natural predators like wolf and lynx. His overall appreciation of the problems caused by, and encountered by the deer, and best management procedures, both for conservation and exploitation, make this a delightful and informative read.

Ian C. McCallum

The Current Status of the Brown Hare *(Lepus europaeus)* in Britain

MICHAEL R. HUTCHINGS & STEPHEN HARRIS

J.N.C.C. , Peterborough, 1996, 78 pp., softback with numerous labels and maps. ISBN 1 86107 404 2, £12.50.

This is the latest in a long series of splendid and extremely well presented reports produced by the J.N.C.C., which cover so many aspects of environmental change in the British Isles. This current publication deals with the Brown Hare, which has undergone many changes during this present century, the most dramatic of which was probably the population explosion of hares following the introduction of myxomatosis, which reached the West of Scotland around 1953, and the consequent vast fall in the rabbit population. Subsequent history has shown great variations in distribution and population throughout the country, and an up-to-date national survey was clearly desirable.

This the authors have now carried out, and have also bravely tackled the exceptionally difficult task of assessing actual numbers. So far only a very few species, mainly birds, have had assessments of their national abundance attempted, with very variable results. In this report, Section 2 sets out the original and often pioneer methods the authors have adopted to calculate numbers, the basis of which seems to be extremely sound, and their efforts are to be highly commended. Section 5 considers the relationship between field sports and hare population, and it is probably not surprising to discover that hare populations are locally higher where gamekeeping is directed towards hare preservation for field sports - hunting, coursing and shooting. Interestingly enough, it is suggested that control of natural predators seems to have little effect on hare populations, rather protection from human poachers. With so many other possible factors involved, however, this case will always be difficult to prove.

The resolute efforts of the authors to assess national abundance, and the influence of habitat thereon, occupy the central Sections (3 and 4) of the report, and will be read with admiration by all interested. This is likely to be the most comprehensive national account of hare distribution and population we will receive for a very long time to come, and sadly the overall picture indicates a steady, and possibly accelerating, national decline.

Many local volunteers were apparently used in making the survey, which is very satisfactory, but somewhat less satisfactory is the authors' seeming lack of awareness of much of the locally published work on mammal distribution, sometimes quite detailed and so useful in establishing historical changes in local status throughout the country. Virtually every national survey of any species relies very heavily on the work done locally, usually by the members of committed natural history organisations. In fact, without the efforts of the countrywide network of local natural history recorders, often devoted amateurs happily working in their limited spare time, our knowledge of the national distribution and population of most fauna and flora would be very poor indeed. With regard to mammals, during the past half-century the West of Scotland could reasonably claim to have been far and away the best recorded part of the British Isles, with a long series of published papers and atlases, a good part of the information appearing in the pages of the *Glasgow Naturalist.* The report's summary does claim that local mammal accounts have been consulted, but members of the Glasgow Natural History Society who read this publication, in many ways so excellent, will search in vain for even the slightest reference to all the West of Scotland work.

J.A. Gibson

Ecology, Evolution and Behaviour of Bats

PAUL A. RACEY & SUSAN M. SWIFT (eds.)

Symposia of the Zoological Society of London No. 67, Oxford, 1995, 421 pp., hardback with line drawings and black and white photographs. ISBN 0 19 854945 8, £75.00.

This professional volume, which records the proceedings of a symposium held during November 1993 by the Zoological Society of London and the Mammal Society, contains 26 papers by 53 authors from 9 different countries. It is divided into five parts, each dealing with a different aspect of bats. Part 1 discusses the problem of bat monophyly or diphyly, bat relationships and the origin of flight. Part 2, concerned with fruit bats, discusses their role in Pacific island ecosystems, their feeding ecology in the Philippines and their interactions in Australian ecosystems. Part 3 dealing with reproductive biology, physiology and energetics, discusses the use of stable isotopes to study diets, the energetics of pteropodids, maternal investment and post-natal growth, lactation in vespertilionids, synchrony and seasonability of reproduction in tropical species and reproduction in Australian flying foxes. Part 4, ecology and ecophysiology of Microchiroptera, deals with nocturnality water balance, dispersal in colonial species, physiological ecology of hibernation, the effects of energy or calcium availability on reproduction and echolocation and foraging in emballonurids. Part 5 is concerned with microchiropteran behaviour and ecology and topics discussed are bats as predators and as prey, the effects of street lamps on the feeding ecology of insectivorous species, the conservation of endangered horseshoe bats, the abundance and habitat selection of vespertilionids in Britain, information transfer in bats, diet selection in mouse-eared bats, mitochondrial DNA variation in *Pipistrellus* and the genetic population structure of the noctule.

Each paper is supported by copious references and the book should prove invaluable to students, researchers and bat enthusiasts.

Ronald M. Dobson

Collins Wild Guides

Flowers

JOHN AKEROYD ISBN 0 00 220004 X

Birds

PETER HOLDEN ISBN 0 00 220003 1

Butterflies & Moths

JOHN STILL ISBN 0 00 220010 4

Harper Collins, London, 1996, 254 pp., softback with coloured photographs and illustrations of each species. £6.99 each.

These are excellent beginner's photoguides, competitively and realistically priced at £6.99. Each book covers about 250 of the commonly seen species in Britain and Ireland for the flowers and birds, and Britain and Europe for the butterflies and moths. They are a nice neat size - will easily fit into the pocket of a cagoule or a Barbour! They have a very attractive and informative page layout displaying one species per page. At the top of each page is a silhouette which gives the overall shape and colour of the family that the species belong to. There is a time bar which tells you which months you might expect to see the species. The birds and flowers have distribution maps and the Lepidoptera have a day/night flying symbol. All entries have good descriptions of form and habits and notes on lookalikes that could cause confusion. For the bird and the butterfly and moth volumes, there are excellent clear colour photographs of each species supplemented by very good illustrations showing respectively, female or young birds or seasonal plumage and male/female, wing undersides or caterpillars. The photographs of the Lepidoptera are particularly useful showing the animals in natural poses in the field. My only criticism lies with the flower volume which matches the others in every respect except the photographs. The author states that with many of the photographs he is trying to give a general feel for the look and habitat of the plant. Fair enough - but it means that many of the pictures fail to provide sufficient close-up detail. Curiously, unlike the other volumes there are no supplemental illustrations which would have been ideal for providing the detail missing in the photographs. This sole criticism aside, these books are excellent starter guides and would make a nice little stocking filler for any budding naturalist!

Maggie Reilly

Collins Wild Guides

Mushrooms and Toadstools of Britain and Europe

BRIAN SPOONER 255 pp. ISBN 0 00 220007 4

Trees of Britain and Ireland

BOB PRESS 191 pp. ISBN 0 00 22000910

Harper Collins, London, 1996, softback with numerous colour photographs. £6.99 each.

There is something attractive about both of these books (two of a series). They are essentially identification guides, with brief introductory essays giving background to the subject covered. Each book covers an impressive number of species (more than 170 trees and more than 240 fungi) in a concise and accessible format. Both are small enough to be easily portable and come in a durable plastic cover to protect them from the rigours of the field.

The main illustration for each species covered is a photograph. This is adequate in the case of *Mushrooms and Toadstools,* the whole of the above-ground structure being shown clearly. However in the case of *Trees,* it is sometimes impossible to make out critical identification characters from the (often general) view provided, although supplementary illustrations compensate for this in many cases. The descriptions in both books are brief and informative - the ID fact-files containing a clear summary of characters for identification. Both books have a glossary of botanical terms used.

In conclusion, both books would represent a useful buy for the serious amateur in either field although other texts would be necessary for absolute identification of species in some cases.

John Phillips

Books received

The following titles were received too late to be reviewed in the present issue. Full reviews will be published in the Glasgow Naturalist for 1998.

Collins Safari Guide: Larger Animals of East Africa

DAVID HOSKING & MARTIN B. WITHERS

Harper Collins, ISBN 0 00 220036 8, £9.99.Collins

Safari Guide: Common Birds of East Africa

MARTIN B. WITHERS & DAVID HOSKING

Harper Collins, ISBN 0 00 220034 1, £9.99.

Scottish Plants for Scottish Gardens

JILL, DUCHESS OF HAMILTON

The Stationery Office in collaboration with The Royal Botanic Garden, Edinburgh, ISBN 0 11 49580313, £12.95.

Scottish Wild Plants: their history, ecology and conservation

PHILIP LUSKY & JENNY WRIGHT

The Stationary Office in collaboration with the Royal Botanic Garden, Edinburgh, ISBN 0 11 495802 5, £12.95.

Erratum

In Huxley (1996) *Glasgow Naturalist* **23** (1), 48-50: on p.48, second column - in the penultimate paragraph concerning *Hesperocorixa* spp., the statement in brackets about a fourth species of this genus having been recorded in Dumfriesshire is an error, which should be deleted. Apologies of the author.

PROCEEDINGS 1996

The Chairman, place*, number present, lecturer's name and title of lecture are given for most meetings.

*BOB Boyd Orr Building, Glasgow University.
HL Hillhead Library
GKB Graham Kerr Building, Glasgow University

9 JANUARY

Dr Dobson, BOB, 53, 27th Paisley International Colour Slide Exhibition, Natural History Section, Commentary by N. Tait, presented by W. Brown.

13 FEBRUARY

E.G. Hancock, BOB, 40, Prof N. R. Grist, Presidential Address "Yellow Jack and Flying Tigers".

27 FEBRUARY

Prof N.R. Grist, BOB, 56, 66th AGM. Reports were presented on activities during 1995 and elections held resulting in appointments as shown opposite. Membership stands at 270, made up of 227 ordinary, 25 family, 1 junior, 6 school and 11 honorary members. There were 3 Council Meetings and the executive met informally as required.

12 MARCH

Norman Tait, BOB, 53, Phil Lusby, "Rare Plants of Scotland".

9 APRIL

Norman Tait, BOB, 30, Mrs Betty Smith, "Dragonflies in Scotland".

14 MAY

Norman Tait, BOB "Deep Sea World".

11 JUNE

Summer Social to Loch Katrine. 25 Excursions were arranged for the summer months.

4 OCTOBER

GKB, 40, Exhibition and Wine and Cheese.

8 OCTOBER

Norman Tait, BOB, 68, Prof John Davenport, "A Marine Biologist's View of Sub-Antarctic South Georgia", The Second Professor Blodwen Lloyd Binns lecture.

2 NOVEMBER

Joint Exhibition Meeting and Lecture with Botanical Society of British Isles and Botanical Society of Scotland. GKB, Peter Macpherson "An Amateur Field Naturalist in Lanarkshire".

12 NOVEMBER

Norman Tait, HL, 120, Joint with Royal Horticultural Society, and Friends of Glasgow Botanic Gardens. Tim Miles, "The Plants and Gardens of Madeira".

26 NOVEMBER

Norman Tait, BOB, 40, Members Slide Night, 10 contributions.

10 DECEMBER

Annual Dinner, Ingram Hotel, 42, after dinner talk by Robin Noble, "Orkney Isles"

OFFICERS AND COUNCIL SESSION LXVI 1996

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Society Events

photo: Jean Millar

Members of the Society enjoy a botanical ramble on an outing to Kelly Burn, Aberfeldy in June of 1996.

photo: Bill Parkes

The president of the G.N.H.S., Norman Tait, presenting Dick Hunter with a ninetieth birthday card at a dinner in Dick's honour at the Burnbrae Hotel, Milngavie, in April 1996.

Dick Hunter has been a weel kent member of the Society for many decades. He developed an active interest and enthusiasm for plants and fungi during his years in the Society. The birthday card was specially made by Pearl Tait with paper made from various species of local fungi. Jim and Camilla Dickson also prepared a special birthday cake with ninety candles which they promised him on his eightieth birthday. Dick had no problem blowing out all the candles and commented wryly 'If I knew I was going to live so long I would have taken better care of myself!'. We all look forward to his hundredth birthday.

The Glasgow Naturalist

Advice to Contributors

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2. Short notes should not normally exceed one page of A4 when single-spaced. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references.

Short notes may cover, for example, new stations for a species, rediscoveries of old records, additions to records in the Atlas of the British Flora, unusual dates of flowering, unusual colour forms, ringed birds recovered, weather notes, occurrences known to be rare, interesting localities not usually visited by naturalists, and preliminary observations designed to stimulate more general interest.

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Wheeler, A. (1975). *Fishes of the World.* Ferndale Editions, London.

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List of Plates

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The Glasgow Naturalist

Volume 23 Part 3 1998

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

GLASGOW NATURAL HISTORY SOCIETY
(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow or the Glasgow Art Gallery and Museum.

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EDITORIAL

Sowing the Seed ... the first 5 years of the Blodwen Lloyd Binns Bequest

In the 1997 *Glasgow Naturalist*, I wrote (Downie, 1997) of the widespread concern that natural historians are dying out. One solution is to encourage the young - but for that, funding is helpful. It is notoriously difficult to obtain support for basic natural history projects these days. That is why the Blodwen Lloyd-Binns Bequest has been such a boon. It is now 5 or so years since the fund established from the Bequest was set up, and a good time, therefore, for an outsider's view of its progress.

GNHS Council was first informed of the existence of a substantial legacy from the estate of the late Professor Lloyd-Binns (Macpherson, 1992?) in October 1991. She had left the Society the royalties from her "Handbook of Botanical Diagrams". The bequest was unconditional, but she hoped that it might allow the Society to arrange refreshments at meetings to encourage fraternising, and to foster interest in the Society's history, achievements and current activities. Her letter included a long list of suggestions, mainly associated with the history of the society, cataloguing of herbaria and publication of the Flora of Glasgow and other local areas of interest. However, she was determined that the Society should use the bequest as it saw fit: a generous benefactor indeed.

Some organisations might, with this encouragement to fraternise, , have spent the lot on a massive binge, but Council was cannier. They canvassed members for ideas on how best to use this unexpected windfall and established a fund under the administration of a five person team acting as a sub-committee of the Society's Council, comprising a blend of financial, scientific and administrative skills. It was early established that the Bequest should be sensibly invested and that the fund should only spend the new money generated, not the capital. Council was very mindful of the dissipation of Goodfellow's earlier bequest (Grist, 1996).

It is interesting to read, from Council minutes, of how the Society gradually decided on what kinds of use to put the money to, and what to refuse. It was agreed not to subsidise members' participation in field courses outside Glasgow. It was agreed that only 50% of the refreshments costs, so encouraged by Professor Lloyd-Binns, should be paid by the Bequest; Also that 50% of transportation costs should be paid to encourage members' participation in field excursions.

In general, the administrators have been reluctant to make large payments for single projects, £3,000 being the maximum and less than £1,000 being much more common, thus spreading the benefits, rather than concentrating them.

So, what has the money been used for so far? Table 1 shows the various categories of expenditure to date (end 1997).

Council agreed early that the Bequest should be used to enhance the quality of production of the *Glasgow Naturalist*: around £1,000 per year goes to colour printing and other production costs. This seems a very direct way of ensuring that the Society's work is attractively put to a wide audience.

The Bequest has helped to equip the Society better, by means of the purchase of computing software and hardware, microscopes and library expenses. A major debate for the future of the Bequest may be to what extent money should be spent on ensuring the future of the Society's library: this would certainly fall within the range of Blodwen-Lloyd Binns's suggestions, which include finding a home for the Society.

The Bequest supports one prestigious lecture each year, alternately named after Blodwen Lloyd-Binns and Peter Goodfellow. Society social events also receive a small subsidy.

The bulk of the Bequest's income, very properly in my view, has been used to assist natural history projects. The administrators soon agreed on priorities: members over non-members; local over distant projects; projects where the results could be presented to the Society. Anyone seeking a Blodwen Lloyd-Binns Grant must apply, detailing the purposes of the work. It is a condition that the Society should receive a report of all work done under Blodwen Lloyd-Binns support.

The projects supported so far already total an impressive list. Table 2 shows how the 27 projects supported to the end of 1997 were distributed by speciality and location.

There have been very similar numbers of projects home and abroad, but considerably more money has gone to home projects. Zoological projects have pre-dominated over botanical ones, both in number and cost.

The projects abroad have mainly been associated with University of Glasgow Expeditions, supporting work on the natural history and conservation of turtles, large mammals, caiman, amphibians, insects and birds in locations as various as Bolivia, Cyprus, Kenya, Trinidad, Guyana, Seychelles and Ecuador. Mostly, the money has helped young people to get experience of natural history research in new surroundings - an excellent investment of Blodwen-Lloyd Binns funds. If there is a sadness here, it is that so few of these projects have involved a botanical component. It will be interesting to see how many of the young people so supported are able to maintain their interests, and how many become longer term members of GNHS: this will likely depend on where their careers take them.

The grants for projects in the UK have mostly supported long-standing members of the Society in their researches - another excellent use of the Blodwen-Lloyd Binns funds.

There has been considerable support for work on local floras - Glasgow, Lanarkshire and Argyll, notably. In fact, apart from a major award to the Clyde bird database and atlas, the bulk of the UK projects have been botanical. A recent innovation at Glasgow University has been the introduction of a Work Placement year for biological science students. For students in commercially important subjects, these years have been fairly easy to finance. Not so for students in the fields of natural history and conservation. Blodwen Lloyd-Binns has been able to help here, so far funding an excellent project on Scottish wildcats.

Reports of the work done on these projects are now making a significant contribution to GNHS's library, mostly as Expedition reports, but also as papers published in the *Glasgow Naturalist* and elsewhere.

What of the future? Surprisingly in these cash-strapped times, the Bequest has yet to spend all the income generated in each year. This situation will undoubtedly end as the Bequest becomes better known. It may eventually be necessary to narrow the criteria on which awards are based. However, the policy of awarding numerous small grants, rather than a few large ones, should protect the Bequest from major grant applications, and ensure that the money goes to the kind of work which is hard to support from other sources. I certainly hope that the Bequest continues to help young people to gain experience of natural history research: that, after all, is where GNHS's future lies. I also hope that the Bequest will continue to support work done abroad: that would have pleased Blodwen Lloyd-Binns, with her history of adventurous botanising in far countries.

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My thanks to Geoff Hancock and Bob Gray for their very helpful comments on a draft of this article.

Roger Downie

Table 1

Uses of Bequest income (% - from total of £19,200)

Glasgow Naturalist	Equipment	Lectures	Social events	Projects	Administration
13	15	2	3	62	5

Table 2

Distribution of Projects supported (% - from total of 27 and £11,842)

	Subject			Location	
	Zoological	Botanical	Miscellanious	UK	Abroad
Number	63	33	4	52	48
Money	61	38	1	63	37

GLASGOW NATURALIST Vo. 23 Part 3 pp 3 - 4 (1998)

WILDLIFE CONSERVATION IN GLASGOW'S PARKS

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Some of Glasgow's finest parks were originally private estates and were acquired by, or gifted to, the old Glasgow Corporation in the 1800s and early 1900s. There are formal flowerbeds, shrubberies, rockeries and recreation areas for tennis, bowling and other pursuits. Often there are also park ponds, either 'duck ponds' or more usually steep-sided, concrete boating ponds which until recently were used for both rowing boats and for model yachts. The boating has now stopped in most parks but model yachting is still popular. In the summer months ninety percent of Glasgow's residents use their local park for all sorts of activities ranging from jogging and golf through to the more gentle choice of walking the dog. Why then is there a need for a Conservation Section working for the City Council in the city's parks and other open spaces?

The Conservation Section aims to protect the wildlife that already inhabits our city and to encourage more wildlife by enhancing habitats and where possible creating new ones. Glasgow's parks and open spaces, owned and managed by Glasgow City Council, provide vital pockets of green in amongst the urban sprawl. Wildlife corridors such as rivers, burns, disused railway lines and even roadside verges link these pockets and so allow the movement of animals and plants throughout the city. The presence of wild animals and plants in our midst brings pleasure to all sorts of people and increases their enjoyment of their local park environment.

A flowering meadow in summer can be a riot of colour with the yellow of Cat's Ear and Meadow Buttercup, the pink of Ragged Robin, the mauve of Devil's-bit Scabious and the pure white of Sneezewort. The flowers attract butterflies which add to the rainbow effect, and bees and other insects which also feed in the meadow. The Conservation Section is involved in creating and enhancing wildflower meadows in the parks. In Queen's Park and other suitable parks, areas of grassland have simply been left long to allow the grasses and other flowering plants to flower and set seed. At Hogganfield Park school children have planted Bluebells and Primroses in the woodland, in conjunction with the Kelvin Valley Countryside Project. Wildflower seedlings have also been planted in the grasslands at Hogganfield Park in two areas in Cranhill Park. In other areas meadows are created from scratch by preparing a piece of ground and seeding it with a wildflower seed mix, for example at Robroyston Park where a large area in the north of the park has been seeded, and again at Cranhill Park where an annual meadow mix of Corn Poppy, Cornflower, Corncockle and Corn Marigold planted by local children (in conjunction with the Parks Development Officer and the Kelvin Valley Project) produced an amazing show of colour last year and was featured in local newspaper reports. The results not only create habitat for insects but also for small mammals like the Field Vole which forms runs and nests in the grasses, and in the autumn the seedheads are food for small birds.

Wetland creation is also a vital part of the Conservation work taking place in the parks. The loss of wetland areas throughout Britain is a continuing trend due to draining, pollution, infilling and development of land for housing and retail use. This loss of ponds and associated wetlands must, at least partly, be responsible for the decline of our native amphibians which echoes a worldwide trend of amphibian decline. Ponds and wetlands at their best are an extremely rich ecosystem of invertebrates, amphibians, birds and other animals, along with complex communities of wetland plants. One of our most attractive mammals, the Water Vole, which lives on the banks of slow-flowing rivers has been greatly affected by dredging, removal of riverside vegetation and other current management practices for 'river improvements' leading to a drastic reduction in numbers throughout Britain.

Glasgow's Victorian boating and duck ponds have great potential for development as more natural waterbodies in appropriate park settings. In Springburn Park, for example, one of the ponds has been enlarged so that the water level lies above the concrete edge, on soft mud which encourages wildfowl to use it. The new edges of the pond have been planted with a variety of native wetland plants. The naturalized appearance of the pond benefits wildlife and importantly also adds a new dimension of interest to any walk in the park. Responses from members of the public have been very favourable. At Hogganfield Park a new area of open water has recently been dug in the marshy grassland in the east of the park to provide an additional habitat for wildfowl and a breeding habitat for the Common Frog which is known to hibernate in the grassland. At Robroyston Park two clumps of trees have been removed and five new shallow ponds dug in their place, to recreate an original wetland area which was drying out due to the treeplanting. In its first year the new wetland area has attracted Canada Geese, Mallard, Little Grebe, Coot and Lapwing. Glasgow is lucky in having at least two park sites where Water Voles live and hopefully with sensitive management of their wetland habitat it will be possible to maintain their populations and perhaps, through developing and linking wildlife areas, even increase their numbers.

One of the Conservation Section's most important tasks is to monitor the animal and plant species present in the different parks and open spaces in the city. This includes monitoring Sites of Importance for Nature Conservation (SINC for short) which are areas of land anywhere within the city boundaries which have been identified as being of conservation interest by Glasgow City Council. Some of the sites belong to the City Council and some of them are in private ownership. By monitoring the parks and SINCs the number and diversity of species on each site can be recorded and any changes quickly detected. Conservation management plans can thus take into consideration any species of particular note and protect them.

Working in Conservation in an urban setting brings its own unique problems. People-pressure on well-used sites can cause disturbance to wildlife and damage to habitats, unfortunately degrading the very nature of the area to which people are attracted. The solution can often be found by involving the area's user-groups in the care of the site. Parties of school children and community groups help in 'clean-ups', getting rid of the rubbish in their local patch and planting trees and wildflowers as part of activities arranged in conjunction with various conservation bodies, including those funded or part-funded by Glasgow City Council. The Conservation Section promotes environmental education through leaflets and through liaison with others such as the Parks Development Officer and the River Valleys Projects which undertake a great deal of practical conservation work with different groups of people. School pupils out planting young trees often feel quite protective of 'their' trees and continue to visit them and watch them grow. If this appreciation of living things can be expanded and prolonged into a life long interest then the future will be bright for Glasgow's wildlife.

The highly publicised Earth Summit held in Rio de Janeiro in June 1992 has made the public very aware of 'The Environment' and 'Green Issues' which hopefully will increase public concern over the decline of habitats and species. The British Government signed the 'Convention on Biological Diversity' at the summit and subsequently produced the UK Biodiversity Action Plan which has as its goal 'to conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms'. Glasgow City Council has set up its own Biodiversity Action Plan working group to look at the status of animal and plant species within the City boundaries. The varied work of the Conservation Section within the City Council can thus contribute in some small way to national and international objectives for nature conservation, whilst at a local level help to ensure that the sight of Foxes, Kingfishers and Kestrels in the city remains a common one.

Editor's note

Carol Aitken is Assistant Conservation Officer in the Parks and Recreation Department. The value of parks to wildlife is further demonstrated in this issue by the Botanic Gardens wildlife survey reports.

GLASGOW NATURALIST Vol. 23 Part 3 pp 5 - 8 (1998)

LOCH LOMONDSIDE DEPICTED AND DESCRIBED

1. MYTHS, MARVELS AND MONSTERS

JOHN MITCHELL
22 Muirpark Way, Drymen, Glasgow G63 0DX

"Hadst thou a genius on thy peak,
What tales, white-headed Ben,
Could'st thou of ancient ages speak,
That mock the historic pen"

from 'Ben Lomond'
Thomas Campbell (1777-1844)

INTRODUCTION

In this, the first of what is planned as a short series of articles on Loch Lomondside, I intend to focus attention on some of the more persistent legends and strange phenomena associated with the area. When most of these traditional tales which make up Loch Lomondside's folk history were first told is lost in the mists of time. Today, one can only examine the stories as passed down by the printed word and attempt to seek alternative interpretations rather than reject their authenticity outright. Whereas the 'myths' would appear to be exactly that, plausible explanations can at least be offered for the loch's much exalted three 'marvels'. As to whether or not the third deepest loch in Scotland has its own very reclusive large lake creature or 'monster', is left to the reader's personal convictions in such matters.

THE MYTHS

One of the earliest descriptions of Loch Lomond is to be found in the *Historia Britonum* attributed to Nennius, a late 8th century Welsh cleric (Todd, 1848). According to Nennius - or just as likely, one of his translators - the loch contained sixty islands or rocks, with an 'eagle' on every one. Although the number of islands and birds is an obvious exaggeration, there could well have been strong populations of Ospreys *Pandion haliaetus* L. and White-tailed Eagles *Haliaeetus albicilla* L. nesting on Loch Lomondside at that time. What transformed the story with a probable underlying grain of truth into the realms of fantasy was its embellishment by the mid-12th century chronicler, Geoffrey of Monmouth. In his version of Nennius in *Historia Regum Britanniae*, portentous events in the kingdom were foretold by the eagles shrieking in concert (Giles, 1842). But then, one would expect nothing less of Geoffrey of Monmouth's fertile imagination which gave the world the stirring legend of King Arthur and the Knights of the Round Table.

The survival of this next piece of local folk-lore is owed to John Dewar - a gaelic speaking woodsman from Rosneath - who, in the mid 19th century, was engaged by the Duke of Argyll to gather and write down the regional oral stories before they were forgotten and lost. Dewar died at Dumbarton in 1872, being described on his death certificate as a 'Collector of Traditions' (MacKechnie, 1964). In this particular tale, the long struggle for dominance between Scotland and England is portrayed as an epic battle between two bulls on the upper slopes of Ben Vorlich above Loch Lomond. During the fight a huge boulder became dislodged, rolling down the hillside before coming to rest near the shore (Campbell, 1862). The 'Stone of the Bulls' NN 325137 is better known now as the 'Pulpit Rock', for in 1825 a deep recess was carved into the eastern face of the boulder from which the Minister of Arrochar periodically preached to his furthest flung parishioners (Douglas, 1971).

The existence of a fairy people with supernatural powers was once widely accepted throughout Scotland. Place names derived from the gaelic word for fairy *sithean* abound, two local examples being Shian NS 550899 (Johnston, 1904) and Shemore NS 344884 - the big fairy knoll (Irving, 1928). Dark tales about the fairies abducting children were still being perpetuated on Loch Lomondside as late as the 19th century, although Teignmouth (1836) considered the prime intention of preserving the mystic awe was to deter the inquisitive from venturing into certain spots where illicit whiskey stills were concealed. Not all fairies had malevolent reputations. Those which resided around the Fairy Loch NS 338994, a small hillside tarn just north of Inverbeg, were said to dye sheeps' wool or newly spun yarn to the desired hue if left by the waters' edge overnight; and that before departing for ever to their subterranean otherworld, they emptied the contents of their last colour cauldron into the tiny loch. This is the explanation usually offered for objects lying in the deeper water appearing a distinct shade of blue (McLeod, 1884). MacGregor (1927) recounts an almost identical tale, but of a small pool NN 269092 at Lag Uaine - the green hollow - between Ben Ime and Ben Vane. The Fairy Loch was once a popular locus for organised excursions, the Natural History Society of Glasgow visiting the site on at least three occasions (Lee, 1913, 1943 & 1946). Despite this attention, no satisfactory solution was ever arrived at for the tarn's colour phenomenon. Reluctantly setting aside the popular story, the water of the Fairy Loch is remarkably free of organic material, its exceptional clarity favouring the transmission of light towards the blue end of the spectrum.

THE MARVELS

"Waves without wind,
Fish without fins
and a floating island".

There cannot be many people acquainted with Loch Lomond who are unfamiliar with its trio of marvels. They may not be aware however, that there were originally four; the Abbot of Cirencester, Alexander Necham (1157-1217), having asserted that a stick thrown into the waters of the loch would turn into stone (Gibson, 1695). Such a tall tale as wood transmuting instantly into stone was eventually rejected, but the other three marvels have been kept going in one form or other over the years. Not that such wonders were exclusive to Loch Lomond from the beginning. A very early map, prepared by an unknown English cartographer in the mid 14th century, assigned three rather similar phenomena - a floating island, fish without intestines and a passage (sail) without wind - to Loch Tay (Parsons, 1958). That three marvels became firmly attributed to Loch Lomond is thanks to Hector Boece (1465?-1536), Canon of Aberdeen Cathedral and Principal of the City's new university. Working from the manuscript collection of Glasgow born Bishop Elphinstone, Boece's *Historia Scotorum* was first published in Paris in 1527. At the request of King James V, the *Historia* was translated from the original latin into vernacular scots by John Belleden and reissued at Edinburgh in 1536. After giving a physical description of Loch Lomond, Boece goes on to say ... "and in this loch ar thre notable thingis; fische swomand but [without] ony fin; ane richt dangerus and storme wal(wave), but [without] ony wind; and ane Ile that fletis(floats) heir and thair as the wind servis" (Maitland, 1831).

The waves without wind may be accounted for by seiches, which can occur when a particularly strong wind suddenly drops, allowing the 'piled-up' water on the windward side of the loch to move back in the opposite direction. In very extreme cases the displaced water will over-shoot the far shoreline, before turning again in the original direction, the loch surface continuing to oscillate until the momentum is lost. The duration of a seiche is generally short, but on 26 February 1990 when the water level was unusually high, one was observed to last well over 12 hours (Curran & Poodle, 1991). Seiches can also be triggered by violent movement of the earth's crust. A well documented Loch Lomond example was recorded on the morning of 1 November 1775 and coincided with a major earthquake in Lisbon. Without warning Loch Lomond suddenly rose by 0.7m, then dropped away to a low level normally seen only during prolonged droughts. Fluctuations of the loch level continued at five minute intervals for an hour and a half before finally subsiding (Colquhoun, 1756).

It is perhaps understandable that most writers in the past have interpreted Boece's 'fish without fins' as 'serpents', adders *Vipera berus* L. being formerly common on the loch's larger, less wooded islands (Lumsden & Brown, 1985). Lamond (1923) was apparently the first to suggest that this unusual fish was more likely to be the River Lamprey or Lampern *Lampetra fluviatilis* L. which are abundant in Loch Lomond. That the local River Lamprey population is unique - the only population in Britain to undergo its parasitic phase in fresh water instead of migrating to the sea (Maitland, 1983) - adds weight to Lamond's conclusion.

Surging water can and does undermine lakeside vegetation, particularly where a sandy alluvial soil overlies an impervious clay. It seems likely therefore that it is large mats of loosened vegetation breaking away during floods or by storm-driven waves which give rise to stories of 'floating islands'. Hector Boece was almost certainly describing such a natural phenomenon for Loch Lomond. It was later writers, such as John Monipennie (1603), who elaborated on Boece's brief statement, the floating island unaccountably now large enough to support grazing sheep and even cattle. One floating island on Loch Lomond became something of a tourist attraction in the 18th century, a first-hand account being provided by Mary Ann Hanway following a boat trip on the loch in August 1775... "I saw the floating island mentioned by [Tobias] Smollet; it is evidently a part of the bank which the rapidity of the torrent has forced off and carried with it into the lake; it is not large, and often undulates from one side to the other. Sir James [Colquhoun], planted some little trees on it, but they do not thrive, though the sod has a beautiful verdure" (Hanway, 1776). What remains of this particular floating island can still be seen at low water where it settled down (Fig. 1) off the south-west corner of Inchconnachan.

MONSTERS

A belief in the presence of a 'water horse' or 'kelpie' (Gael: *Each Uisge*) in Loch Lomond goes back at least to the early 18th century (Graham, 1724). Despite this early date, Loch Lomond has nothing like the same tradition for an unidentified lake creature as other deep water lochs in Scotland such as Ness or Morar. From a biological standpoint, Lomond's productive waters would be far more capable of sustaining a viable population of exceptionally large animals than any of the deepest lochs in the highlands. Yet all claims that there is *something* in Loch Lomond have been totally overshadowed by the media attention and numerous books written on alleged leviathans in their other more famous Scottish haunts.

It would appear the eye is easily deceived when it comes to possible 'monster' sightings in the loch, more especially when an early morning mist hangs low over the water surface. One Loch Lomond writer (Wood, 1954) pointed to his own experience, after witnessing two horses entering the water and swimming so far out from the shore that they were lost to view. Meaden (1974), looking at British waters in general, considered 'water-devils' (whirling columns of water and spray) provided an alternative explanation for some monster reports. Well developed water-spouts on Loch Lomond are rare, however, the present author having seen only one (21 May 1987) in over 30 years of boating on the loch. Wishful thinking appears to have been responsible for two claimed sightings in the south-east corner of the loch in early July 1968. One was later shown to be a curiously shaped floating log, the other - a succession of 'humps' moving against the current in Balmaha Bay - dismissed by the proprietor of the Balmaha boatyard as nothing more remarkable than a family party of ducks swimming in line (*Lennox Herald* 19 July 1968). An unattributed report of 'two humps' seen in the water off Inchmurrin in September 1972 (Bord & Bord, 1987) lacks sufficient detail for consideration.

An incident involving a long distance swimmer aiming to better the time record held for completing the 36 km length of Loch Lomond occurred in July 1964 (*Lennox Herald* 1 August 1964). The attempt failed when, as it was claimed later, the swimmer was twice attacked by what was claimed to be a giant eel *Anguilla anguilla* L. The then Director of the Glasgow University Field Station was quoted in the press as saying that

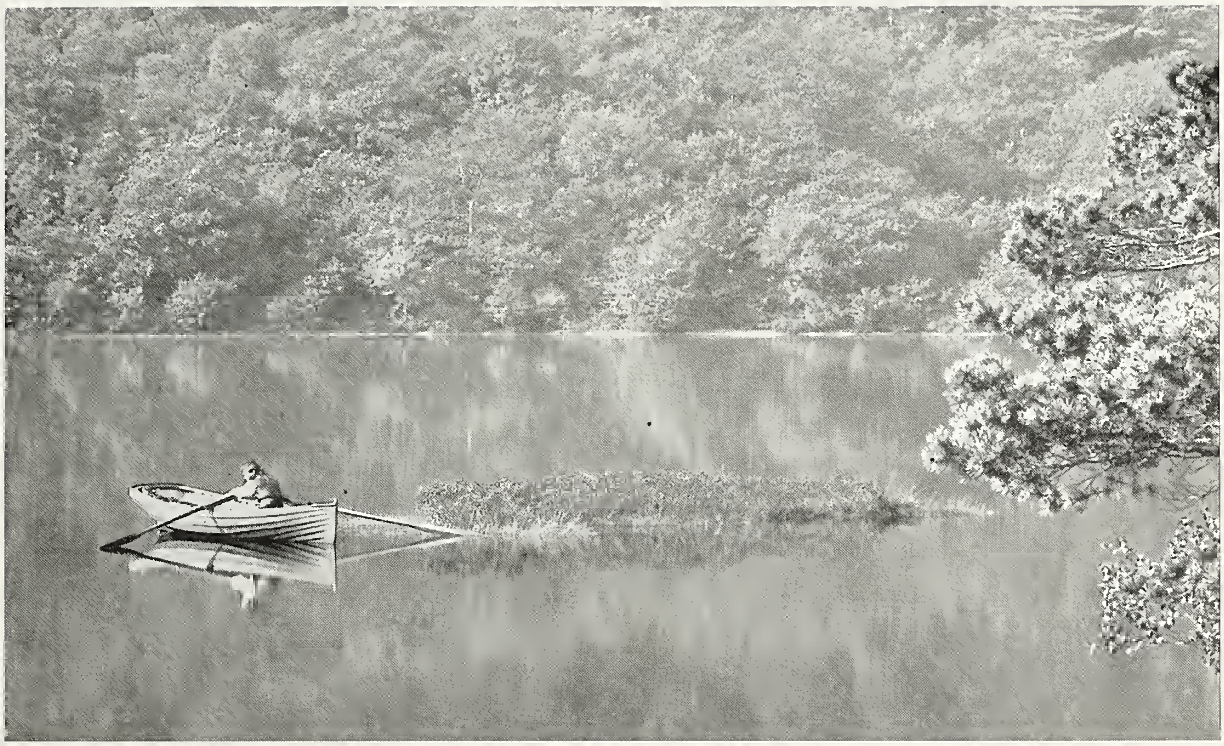

Fig. 1. Remains of the Floating Island in the mid 19th century. G.W. Wilson.

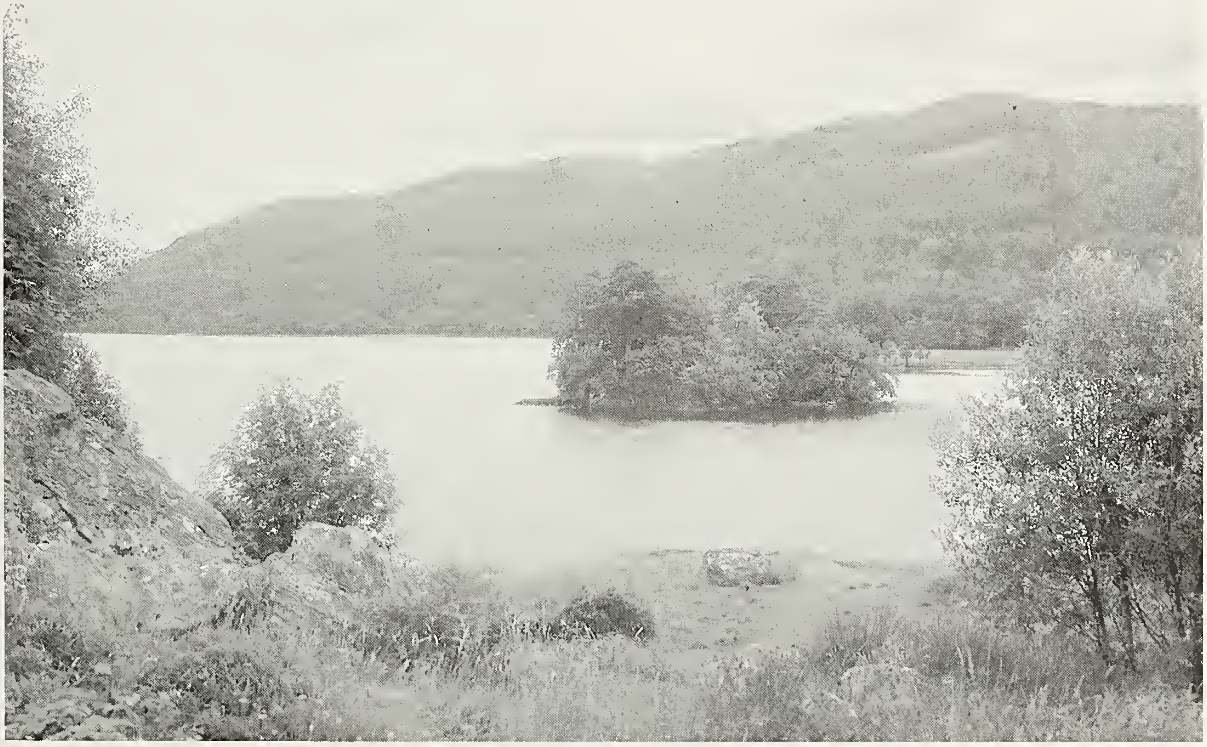

Fig. 2. Inveruglas Bay, Loch Lomond.

it was more likely to have been a large Sea Lamprey *Petromyzon marinus* L. (some individuals growing up to a metre in length), known to enter the freshwater loch from time to time.

Taken together, the most compelling Loch Lomond leviathan sightings were both made in Inveruglas Bay (Fig. 2) in the autumn of 1964. In September of that year, a Helensburgh businessman out in the bay was attending to a stalled outboard engine when his wife drew attention to something large in the water moving steadily past their boat and remaining in view for several minutes. When interviewed later, he commented ... "About 10 yards from us this giant thing was slowly swimming in the water ... It was showing a low hump, I would say about 10 feet long - the length of our boat. It was huge. It was sort of moss brown in colour and smooth with no fins of any kind". He concluded by saying ... "It was some large, living creature, the like of which I have never seen before" (*Helensburgh Advertiser* 2 October 1964). Two weeks after publication of the incident, the same newspaper carried a follow-up story, this time reporting the observations of two railwaymen who had been travelling along Loch Lomondside on the West Highland Line ... "The loch was perfectly clear and calm. We had a perfect view as we came out of the tunnel at Inveruglas and we saw this strange looking disturbance in the water ... It was bigger than a long boat and was moving very fast ... There was a large kind of dark head ... It was far too big to be anything else than a very large creature swimming". At the time of the sighting, neither of the two railwaymen were aware of the earlier encounter in the same locality (*Helensburgh Advertiser* 16 October 1964).

To this day, what it was these four eye-witnesses actually saw breaking the water surface in Inveruglas Bay remains Loch Lomond's most intriguing mystery of them all.

ACKNOWLEDGEMENTS

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THE CAUTIONARY TALE OF LISTER'S STROMB

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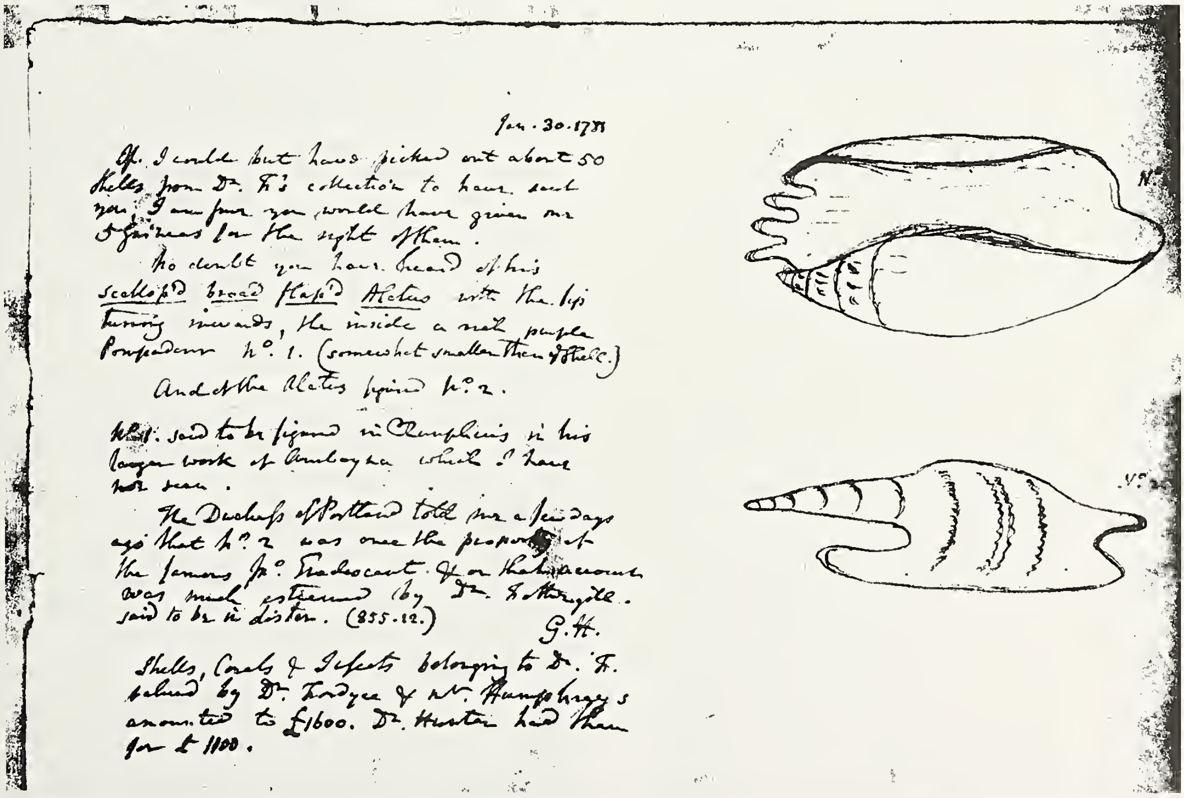
This is the story of a distinctive seashell which comes to notice when it is protrayed in the first comprehensive iconography of molluscan shells, towards the end of the seventeenth century. Then it vanishes into obscurity, to reappear late in the following century when it is added to the collection of a famous surgeon, William Hunter. There it is destined to remain. Half way through the nineteenth century, when it is still unknown to the scientific community at large, a Glaswegian publishes a description of it and gives it the scientific name *Strombus listeri*. A century later the species is still known only by a handful of specimens but it becomes relatively common in collections by the 1970s. In 1986 the Hunterian specimen is irreparably damaged in an accident, questions are raised about its value, and substantial compensation is paid. End of story. Like many stories it begins romantically but ends violently. A story soon told because the facts are few, it is worth setting down here because it follows the vicissitudes of a unique natural object over almost four centuries, involves a distinguished cast of names, and assembles some facts and suppositions which may otherwise be lost.

On 30th January 1781 George Humphrey (1745?-1825), one of the principal dealers in shells and other natural curiosities in Britain at that time, wrote the following letter to Richard Pulteney (1730-1801), physician, botanist and shell collector. The letter concerned some shells in the collection of Dr John Fothergill (1712-80) which had just been purchased by Dr William Hunter (1718-83) for his museum in Glasgow. Pulteney copied the letter which was illustrated with two drawings of shells, numbered 1 and 2 (Figure 1). 'If I could but have picked out about 50 shells from Dr F's collection to have sent you', said Humphrey, 'I am sure you would have given me 5 guineas for the sight of them./ No doubt you have heard of his Scallop'd broad flap'd Alatus with the lip turning inwards, the inside a rich purple/ Pompadour No. 1 (somewhat smaller than ye shell.)/ And of the Alatus Figured No. 1./No. 1. Said to be Figured in Rumphius in his/ larger work of Amboyna which I have/ not seen./ The Duchess of Portland told me a few days/ ago that No. 2 was once the property of/ the famous Jno. Tradescant & on that account/ was much esteemed by Dr Fothergill./ Said to be in Lister (855.12)/ G.H.' (Pulteney, n.d.)

Pulteney added the following note to his copy of the letter: 'Shells, Corals & Insects belonging to Dr F./ valued by Dr Fordyce & Mr Humphreys' amounted to £1600. Dr Hunter had them/ for £1100.'



Jan. 30. 1781

If I could but have picked out about 50
Shells from Dr. F's collection to have sent
you; I am sure you would have given me
5 Guineas for the sight of them.
No doubt you have heard of his
Scallop'd broad flap'd Alatus with the lip
turning inwards, the inside a rich purple
Pompadour No. 1. (somewhat smaller than ye Shell.)
And of the Alatus figured No. 2.

No. 1: said to be figured in Rumphius in his
larger work of Amboyna which I have
not seen.
The Duchess of Portland told me a few days
ago that No. 2 was once the property of
the famous Jno. Tradescant & on that account
was much esteemed by Dr. Fothergill.
said to be in Lister. (855.12.)
G.H.

Shells, Corals & Insects belonging to Dr. F.
valued by Dr. Fordyce & Mr. Humphreys
amounted to £1600. Dr. Hunter had them
for £ 1100.

Figure 1: George Humphrey's letter to Richard Pulteney. (The script of the letter is transcribed in the article).

We pass over the Scallop'd broad flap'd Alatus, clearly a specimen of the south-west Pacific species *Strombus sinuatus* Lightfoot, 1786, to concentrate on the other shell, now known universally as *Strombus listeri*, Lister's Stromb. Pulteney's copy of the Humphrey letter, the key document, takes the story of this shell back to the mid-seventeenth century, at least, to a time when natural curiosities such as exotic shells were regarded as the playthings of a few dilettante collectors. For John Tradescant is a name associated with the development of gardening and the study of natural history in Britain during the first half of the seventeenth century. If the connection with Tradescant can be validated Lister's Stromb may be regarded as the earliest example of a shell preserved as part of a collection of natural objects, in Britain at least. It would make it contemporary with the most famous item in the Tradescant collection, the Dodo, parts of which are still extant.

There were two John Tradescants, the Elder, who died in 1638, and his son, the Younger, who was born in 1608 and died in 1662. In 1656 John Tradescant the Younger published a catalogue of the 'Rarities' amassed by him and his father (Tradescant, 1656). Class IV of the catalogue (pp. 10-14) lists the 'Shell-creatures', including 'Testacea' (or shells). None of the names on his list seems to have an obvious connection with Lister's Stromb, although it has been suggested that his 'Buccina striata' is the very shell (Leith-Ross, 1984:160). This is supposition merely, however, and the Tradescant connection rests on the hearsay evidence provided by George Humphrey. His source was the second Duchess of Portland, Margaret Cavendish Bentinck (1714-85), celebrated for her extensive collections of natural and artificial curiosities. An enthusiastic conchologist, her collection of shells was the finest in private hands in her day and she would have been aware of the existence of rarities, such as Lister's Stromb, in other collections. Her comment to Humphrey may reasonably be taken as *prima facie* evidence for a connection between the shell and the Tradescant collection.

Humphrey's letter also says, 'said to be Lister. (855.12)' This is a reference to Martin Lister's monumental *Historia Conchyliorum*, the first comprehensive iconography of shells (Lister, 1685-92). Plate 855 Figure 12a (Figure 2) of the first edition of that work is an unmistakable engraving of Lister's Stromb. Furthermore, the engraving, apart from showing the upper extension of the outer lip slightly too long, is a tolerably accurate representation of the shell as it was when entire. The caption to Lister's Figure does not indicate ownership of the shell but almost certainly it was formerly in the Tradescant collection as no other example of Lister's Stromb was known before 1870.

After the sale of the Tradescant collection Lister's Stromb must have changed hands several times before John Fothergill acquired it almost a century later. By 1807, however, it reached its final destination, the Hunterian Museum in Glasgow. Whilst still in London in the years immediately after William Hunter's death, the shell was entered in the Trustees Catalogue by Dr George Fordyce (1736-1802), a friend of Hunter with a fine shell collection of his own. The shell is listed therein under the genus *Strombus* as 'tradescantia', an entry supporting its former prescence in the Tradescant collection. Further support for the Tradescant connection is provided by John Laskey's published catalogue of the Hunterian Museum in which the shell is listed under the genus *Voluta* as 'Tradescantia, S. Sir John Tradescant's Volute, unknown, Unique' (Laskey, 1813:104). The 'S.' in this entry stands for Daniel Carl Solander (1733-82), the gifted pupil of Linnaeus who helped catalogue the Duchess of Portland's shells, sold with the rest of her collections a year after she died (Lightfoot, 1786). Laskey's catalogue entry suggests that Solander may even have handled the shell at some time. Like the Duchess he was still alive when the Fothergill collection was sold to William Hunter.

The Hunterian shell - and consequently the species it represents - remained unknown to students of systematic conchology until the middle of the nineteenth century. London-based conchologists such as the various members of the Sowerby dynasty, the brothers Arthur and Henry Adams, Lovell Augustus Reeve and Sylvanus Hanley seldom travelled as far north as Glasgow to study private collections and they would have considered William Hunter's too old fashioned to be worth the trip anyway. It was left to a native of Glasgow to demonstrate that this shell which had already been around for about two centuries had never been officially described or given a valid scientific name.

As a young man Thomas Gray (1820-1910) was one of a group of keen naturalists living in the Glasgow area which, in 1851, established the Natural History Society of Glasgow. Gray became one of the most active members, concentrating his attention on conchology. In 1852, the year he was elected Vice President of the Society, he gave a series of lectures on shells at Anderson's College (now the University of Strathclyde). As the lectures were well attended and popular it is not surprising that Gray was invited by the Principal of Glasgow University to arrange and classify the shell collection in the Hunterian Museum. When he was engaged on this task he recognised the distinctive features of the stromb shell which he was destined to describe and name. He wasted no time in publishing the description of the shell which he called *Strombus listeri*, in honour of the man who had published an engraving of it many years before (Gray, 1852). In his description he said, 'it is not at all improbable that this specimen was the very individual from which the figure in Lister was taken, as it agrees perfectly in size as well as general contour and is evidently, from the comparative faintness of its coloration, as well as its general appearance, a very old shell". At the same time he was allowed to make a drawing of the shell, intended for publication, but it never appeared.

Gray was an accomplished artist, as is proved by several bound volumes containing drawings of shells in water-colours. A two-volume work on land shells belonging to the Mitchell Library, Glasgow, shows Gray's artistry at its best, the drawings being both precise and aesthetically pleasing. Two other volumes belonging to the Kelvingrove Museum, Glasgow, show that, with few exceptions, he maintained a consistently high standard when depicting shells (Dance & Woodward, 1986). None of these volumes contains an illustration of

Strombus listeri although, as we have seen, Gray is known to have prepared a drawing of it. In 1996, however, a slender volume containing a further nineteen of his shell drawings (Gray, n.d.) was acquired for the Kelvingrove Museum. Fortunately, one of them shows two exquisitely drawn views of the shell, presumably executed in 1852. The drawing, reproduced here is colour (Figure 4, back cover), is inscribed in ink 'Strombus Listeri. T. Gray./ Mus. Hunter. Glasg/" A pencilled addition in Gray's hand reads, 'See Lister Hist. Conch. Pl. 855 fl2a'.

As the published description of *Strombus listeri* was not illustrated - no fault of Gray's - it was generally overlooked. So a second example of the species which turned up a few years later was described by G.B. Sowerby, 2nd, as new to science and named *Strombus mirabilis* (Sowerby, 1870). It was to be many years before further specimens were discovered and specialists were slow to realise that Gray had already described the same species under another name. Up to 1960, when only five specimens of *Strombus listeri* had been recorded, it was said to be 'one of the rarest and most desirable of the world's Strombus' (Abbott, 1960: 115). By the 1980s, however, many examples had been obtained from its strongholds in the eastern Indian Ocean.

Lister's Stromb was a desirable rarity no longer but the Hunterian shell retained a special aura: it was very old, it was for many years the only specimen known, it was the holotype of the species, and it had been owned or handled by a succession of distinguished personages. Because of its historical interest (Figure 3, back cover), the Hunterian shell was protrayed in a standard work on the history of shell collecting (Dance, 1966). In 1986, partly to celebrate the launch of the second edition of that work in which the shell was again portrayed (Dance, 1986), it was borrowed from the Hunterian Museum for an exhibition staged in the Kelvingrove Museum. At about 8.30 a.m. on 2nd September, the day before the exhibition was due to open, disaster struck. While being suspended over the entrance to the exhibition a heavy title board slipped and fell onto two pedestal-type cases containing shells. One of the cases contained the precious - and fragile - Hunterian shell. Cruschcd by the weight of the case, it broke into more than two hundred fragments. The sorry tale of the accidental demise of the shell and the ensuing problems of evaluation and remuneration have been dealt with fully elsewhere (Hancock, 1995).

An attempted reconstruction, using the services of a professional ceramics conservator, was only partially successful, two large pieces and about forty small fragments being the end result (Figure 5). A report on the reconstruction notes that the specimen 'retains its historical value and most of its scientific value but is no longer any use for illustration or exhibition' (Reilly, 1996).

The only positive outcome of the accident was the discovery of forams and other microfauna in the fine sand which spilled out when the shell was crushed. The material was examined closely by Dr Robert Wynn Jones, an expert micropalaeontologist, who has analysed his findings in the accompanying table (table 1). The scanning-electron micrographs show two of the forams identified: they are *Globigerinoides triloba* or *quadrilobata* (Figure 6) and *Heterolepa margaritifera* (Figure 7). Together with the other forams and the ostracods listed in the table they comprise an assemblage typical of the outer shelf of the Eastern Indian Ocean, from about 100-1000 fathoms depth at low to moderate latitudes. The shell may have come to rest nearer than this, for it is possible, indeed probable, that it was drawn up on a ship's lead line (a line with a weighted and greased end used to test the depth and nature of the sea floor). The assemblage has an Indo-Pacific aspect but it is not possible to be more precise than this. So it does not provide any additional clues to the original source of the Hunterian shell.

This, then, is the eventful history of a uniquely interesting natural object amongst the most celebrated if little publicised items in the Hunterian Museum at Glasgow which was crushed accidentally on what may have been the one occasion when it was allowed out of that institution. Fortunately, some excellent portraits of the complete shell in various media were executed at different times. These, at least, help to mitigate the disaster which reduced to fragments a shell which had survived intact for almost four centuries.

Table 1

List of Foraminifera and other organisms from the *Strombus listeri* sand.
Transcript of Robert Wynn Jones's list. Items 1 - 24 are the key to a reference slide deposited in the Zoology Section of the Hunterian Museum by Dr Wynn Jones

Planktonic foraminifera

1. *Globigerinoides quadrilobatus* (D'Orbigny 1846) includes *G. immaturus* and *G. triloba*
2. *Globigerina bulloides*, D'Orbigny, 1826
3. *Globigerella obesa* (Bolli, 1957)
4. *Pulleniatina obliqueloculata*, Parker and Jones, 1865
5. *Globigerinoides ruber* (D'Orbigny 1839)
6. *Globorotalia scitula* (Brady 1882)

Benthonic foraminifera

7. *Spiroculina* cf. *communis*, Cushman and Todd, 1944
8. *Adelosina* sp.
9. *Quinqueloculina*? sp.
10. *Lenticulina* sp. 1
11. *Lenticulina* sp. 2
12. *Sphaeroidina bulloides* D'Orbigny 1826
13. *Loxostomum amygdalaeformis*, Brady 1881
14. *Brizalina spathulata* (Williamson 1858)
15. *Heterolepa margaritifera* (Brady, 1881)
16. *Heterolepa praecincta* (Karrer 1868)
17. undeterminate
18. *Anomalinoides flinti* (Cushman 1931) (?*Melonis affinis* juv.)
19. *Hanzawaia* sp.
20. *Eponides berthelotianus* (D'Orbigny 1839)
21. *Pseudortalia schroeteriana* (Parker and Jones, 1862)

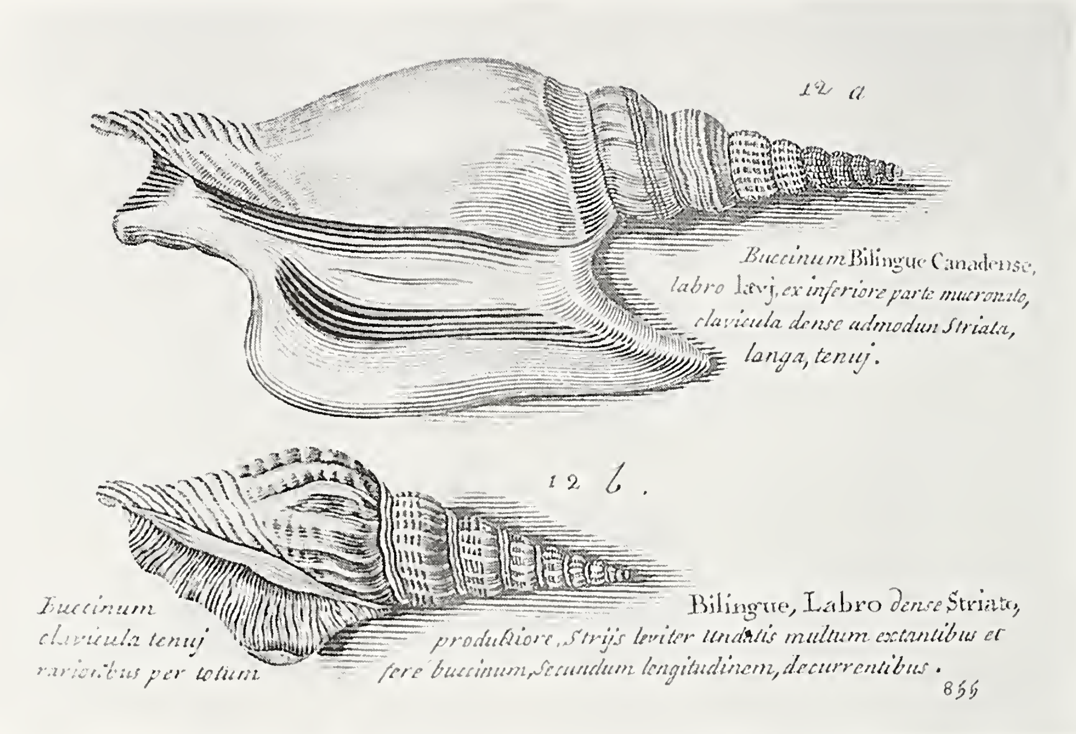

12 a
Buccinum Bilingue Canadense, labro lævj, ex inferiore parte mucronato, clavicula dense admodun Striata, langa, tenuj.
12 b.
Buccinum Bilingue, Labro dense Striato, clavicula tenuj produbtiore, Strijs leviter undatis multum extantibus et rarioribus per totum fere buccinum, Secundum longitudinem, decurrentibus.
855

Figure 2: The plate of Lister's stromb from the *Historia Conchyliorum*

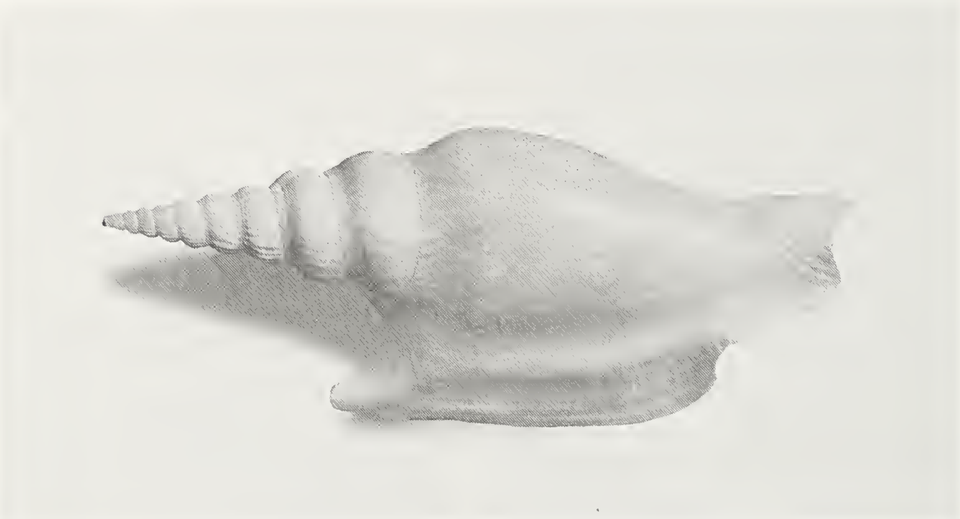


Figure 3: *Strombus listeri*, the complete shell

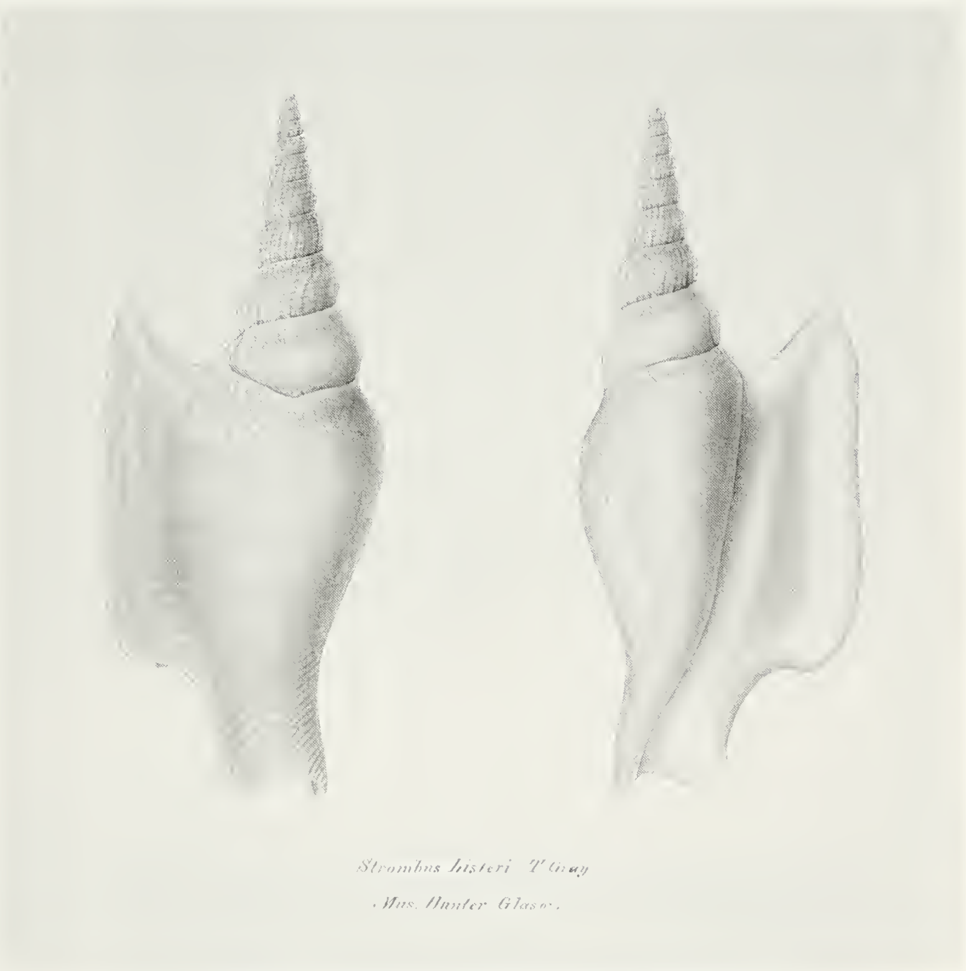


Figure 4: Thomas Gray’s drawing of *Strombus listeri*

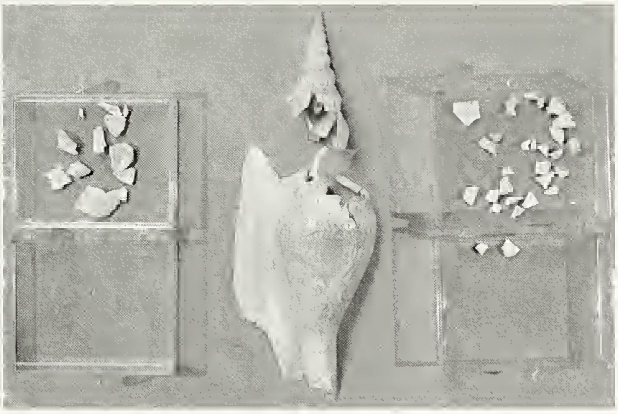


Figure 5: The partial reconstruction of the shattered shell

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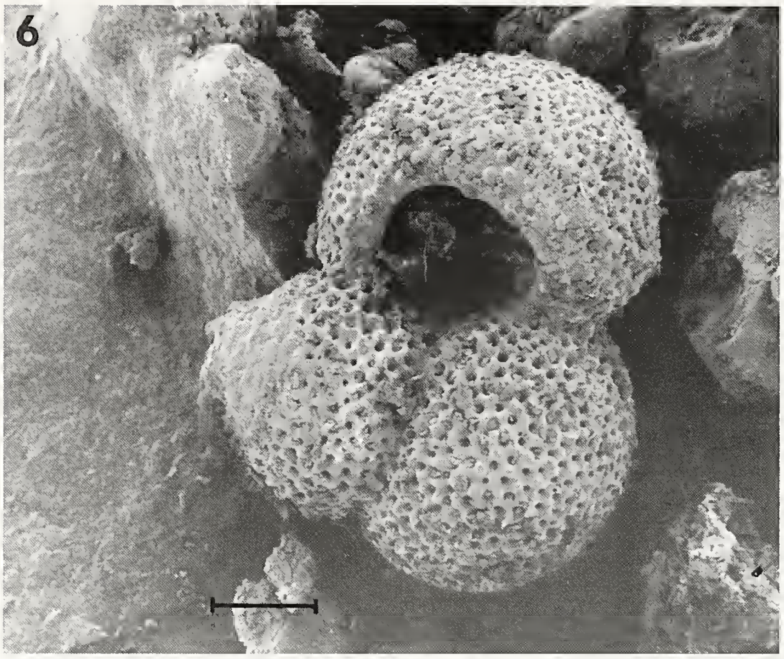

Figure 6: SEM of *Globigerinoides triloba* or *quadrilobata*, one of the species of foraminifera in the shell sediment (scale bar = 100 μm).

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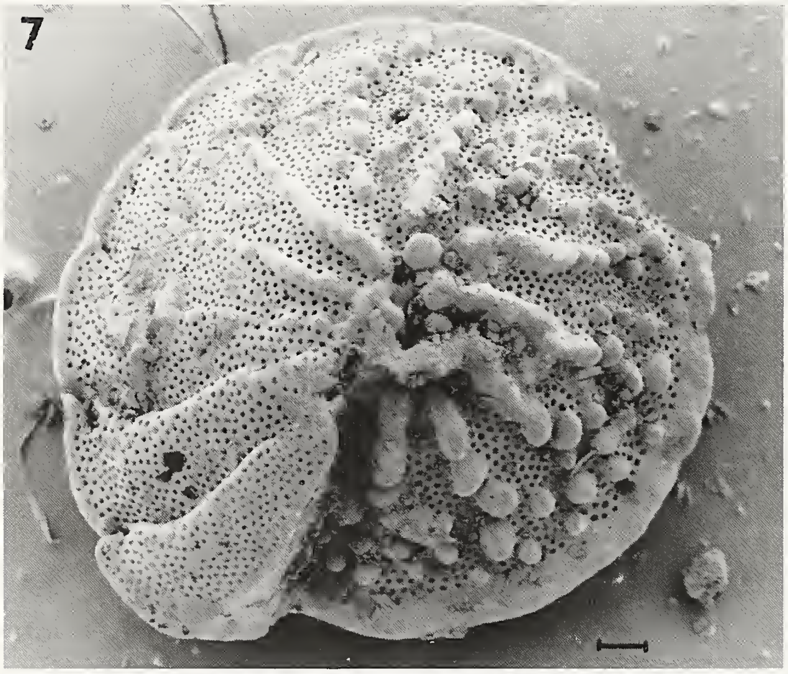

Figure 7: SEM of *Heterolepa margaretifera*, one of the species of foraminifera in the shell sediment (scale bar = 100 μm).

Ostracoda
22. *Cytherella*
23. bairdiid
24. trachyleberidid

Other groups
Scaphopods (*Dentalium* sp.?)
microgastropods
microbivalves
echinoid debris
pteropods (*Limacina* sp.?)

ACKNOWLEDGEMENTS

We are very grateful to Richard Sutcliffe of the Science Department of Glasgow Museums for providing us with a copy of Gray's coloured drawing of the shell. We are also grateful to Geoff Hancock and Fred Woodward formerly of Glasgow Museums for useful discussions and drawing our attention to the existence of the Gray drawings. We would like to thank Dr Robert Wynn Jones for identifications of the forams in the shell sand and Professor John Murray and Dr Andrew Gooday of the Southampton Oceanography Centre for further help with identifications of the foraminifera. Kathie Way of the Natural History Museum, London kindly made available a photocopy of the note in the Pulteney Correspondence.

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The Holocene History of Scots Pine (*Pinus sylvestris* L.) at Loch Sloy, Scottish Highlands

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ABSTRACT

Ancient Scots Pine stumps are commonly revealed by erosion of Scottish peat bogs especially in the Highlands. Stumps of Scots Pine which grew about 4750 years ago (calibrated C14 date) were recently discovered on the upper shores of Loch Sloy. With data from pollen and macroscopic fossil analyses, peat stratigraphy and radiocarbon dating, a relationship between the former growth of Scots Pine at Loch Sloy and intermittent fires is postulated; this is consistent with the ideas of palaeoecologists who have considered that fires may have been necessary to have allowed Scots Pine to grow on water-logged or otherwise unfavourable peat. On the basis of the 5% pollen threshold, it is deduced that Scots Pine grew around Loch Sloy between about 5000 and 3000 years ago.

INTRODUCTION

In 1997 a 2.5m long core of peat was recovered from the shore of Loch Sloy, an artificial reservoir, where Mr John Mitchell had previously noticed stumps of Scots Pine. As part of an ongoing investigation into the Holocene (post-glacial) history of Scots Pine in Scotland, the site was investigated using pollen and macrofossil analyses and radiocarbon dating of one of the stumps. The precise aims of the project were to determine:

1. When Scots Pine first colonised the area,
2. The exact period of growth of the trees that remain as stumps,
3. When Scots Pine became extinct in the area,
4. To compare the history of the Scots Pine at Loch Sloy with that of the trees in Glen Falloch, 12 km to the north-east, where the southernmost, extant, native British population grows.

The occurrences of Scots Pine in Scottish peat bogs have caused much comment over a long period, certainly back to the 18th century. The paper by Hilary Birks (1975) was a major, modern contribution to the understanding of the chronology and ecological settings of the preserved stumps, especially with regard to the importance of fire in allowing establishment of the trees on peat bogs. Since Hilary Birks' work, the increasing application of pollen analysis and radiocarbon dating to the elucidation of woodland history has made it abundantly clear that Scots Pine has had a very complex history in Britain, and Scotland in particular, since the last Ice Age, that is the last 11250 years (Bennett 1984, Hilary Birks 1972, 1975, John Birks 1989, Bridges *et al.* 1990, Dubois and Ferguson 1985, Gear and Huntley 1991).

The most recent attempt at a review of knowledge of the history of Scots Pine in Scotland is that by Bennett (1995). Among his six principal conclusions are two that are particularly relevant to this investigation.

Firstly, he states (p.35) "the spread of Pine was favoured by human activity after 5700 years ago, and it was the only tree to increase its range as the overall extent of woodland in northern and western Scotland contracted". Secondly, "in northern and western Scotland Pine was one of the forest dominants through the mid Holocene, but decreased in abundance at about 4400 years ago. This pine decline was irregular and patchy over the period 5200-3200 years ago, and possibly a consequence of climatic variation, especially involving precipitation".

Scots Pine readily colonises a variety of soils; highly podsolised, sharp draining sand and gravel are preferred, but also bog surfaces, depending on the type of peat and surface wetness. Scots Pine seedling establishment requires a symbiotic mycorrhiza. Colloidal *Trichophorum caespitosum* (Deer Grass) and *Molinia caerulea* (Purple Moor Grass) peat are deficient in phosphorus, essential for mycorrhizal growth, while *Calluna* (heather) peat is though to contain an allelopath which kills the mycorrhiza; both are therefore unsuitable for the establishment of Pine. Mesotrophic *Phragmites australis* (Common Reed) peat, however, contains the mycorrhiza and is conducive to the establishment of Pine seedlings (Birks, 1975).

According to Bennett's 1995 distribution map (Fig. 1), based on macrofossils, which are unequivocal evidence of former presence, Scots Pine has grown throughout most of Scotland, at some places more or less abundantly, at some time during the Holocene. The problem concerns the interpretation of pollen values as an index of presence. *Pinus* produces very large quantities of pollen which can travel over great distrances. Pollen analysts have mostly cautiously adopted a value of 20% of total pollen as necessary to prove local growth but now Bennett, following Fossitt (1994), has argued that only 5% suffices. On that basis, Scots Pine had spread across much of Scotland by 8,800 years ago but in low abundance.

SITE DESCRIPTION

The studied site is situated on the west shore of Loch Sloy (National Grid reference NN275137) at latitude 56°16' N, longitude 4°48' W, at an altitude of 290m above sea level and with a south-easterly aspect. This is near the intersection of Loch Sloy, Strath Dubh-uisage and Allt a Chnoic (Figure 2). The area is surrounded by high hills, Cnap na Criche (515m) to the north, Beinn Dubh (773m) to the south, Conc (492m) to the west and Ben Vorlich (941m) to the east. Most of the site overlies Beinn Bheula schist, a metamorphosed Dalriadan sediment. The area over which soil has developed is now covered by ombrotrophic blanket bog. To the north and west of the site the alien conifer *Picea abies* (Norway Spruce) has been extensively planted. The stumps have been eroded from the lochside peat when the water level has been high (figure 3).

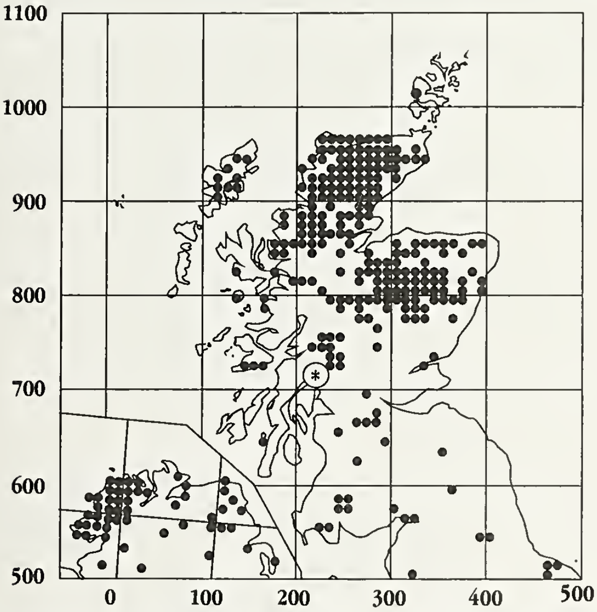

Figure 1. Stumps and other large remains of Scots Pine from peatlands in Scotland and adjacent regions, modified from Bennett (1994). The remains vary greatly in age some going as far back as 7000 years ago. The asterisked circle shows the location of the Loch Sloy stumps.

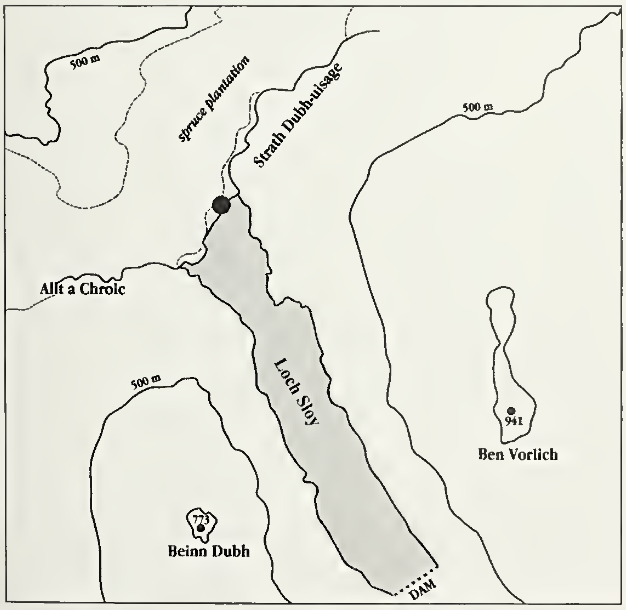

Figure 2. The Loch Sloy area. The location of the stumps is indicated by the black disc. Contours and spot heights are shown in metres above sea-level.

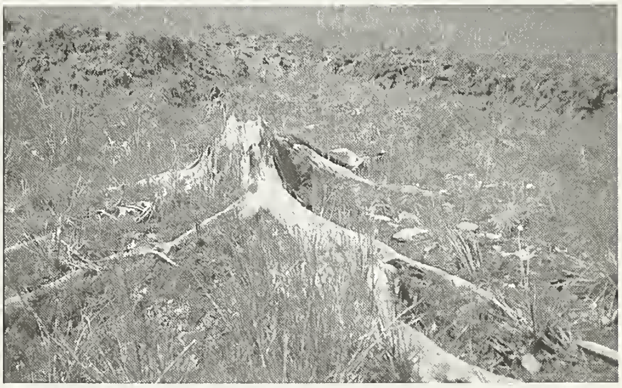

Figure 3. The Scots Pine stump which grew within a few meters of the dug out peat face used for pollen analysis, just out of picture top left. A piece of root wood from this stump was used for carbon dating and annual growth ring analysis.

Due to its proximity to the lochside the vegetation surrounding the stumps is a transition type including elements of National Vegetation Classification type M6, acid small sedge fen, and M24c, acid *Molinia* grassland.

SAMPLING OF PEAT, POLLEN AND MACROFOSSILS

At the face of an exposed peat hag bordering the site of the *in situ* stumps, two 0.5m metal boxes were forced into the prepared peat. Once full they were removed and the 2m of peat below was collected as four 0.5m cores, with the use of a Russian peat borer. The lowest core was incomplete and was not studied, but the coring had provided a 2.5m long sample. All of the samples were stored under refrigeration on return from the site.

One of the *in situ* stumps provided two macrofossil samples, one of which was sent for radiocarbon analysis. The other was examined microscopically in an attempt to deduce the conditions for growth from the annual growth ring pattern.

For pollen extraction and concentration 2cc samples of peat were removed from the cores at various depths. These were prepared for examination by the acetolysis method (Moore, Webb and Collinson 1991). The pollen was mounted in silicone oil and examined at x400 magnification. The pollen proved to be both sparse and poorly preserved. Counts were of 150 total pollen and spores. Identification was made with reference to Moore, Webb and Collinson (1991). Due to their similarity the pollen of Hazel and Bog Myrtle were counted together as coryloid and included amongst the arboreal pollen. The results of pollen analysis are presented as pollen diagrams, generated using the Tilia pollen diagram programme (Figures 4 and 5).

RADIOCARBON DATING

The single radiocarbon date, from the *in situ* Scots Pine stump exposed at the lochside, gave an age of 4200+/-50 radiocarbon years B.P. (before 1950 AD), expressed at the one sigma level of confidence. Using the OxCal conversion this gives an age of between 2910 and 2610 calibrated years B.C. Therefore, these Scots Pine trees were alive about 4750 years ago.

RESULTS

Peat Stratigraphy and Macrofossils

The peat recovered from the Loch Sloy site, comprised three distinct peat types, as described by the Troels-Smith method.

Stratum A 0-6 cm. Sh3Ga1, highly disintegrated and decomposed organic matter interlaced throughout with fine sand 0.06 - 0.6 mm. Few plant remains were recognisable except the roots of present surface vegetation. The junction between stratum A and B was diffuse, but discernible. The sand has probably been deposited since the reservoir was created; during that time the area has been susceptible to periodic inundation by water containing mineral material eroded from elsewhere around the Loch. The reappearance of the stumps is due to erosion of the lochside peat.

Stratum B 6-215 cm. Th^{4}4 T1+ Ag+. The surface vegetation's roots penetrated down to 150 cm, but as in stratum A most plant material was highly decomposed. There were, however, exceptions and most of the macrofossils were found here. The junction between strata B and C was easily discernible due to the nature of stratum C.

Stratum C 215-250 cm. Tb^{4}4, a darker, uniform, greasy peat of highly humified mosses. Microscopic examination found it to be composed almost entirely of mosses with some small roots and branches. Some of the mosses were still identifiable.

The macrofossils removed from the core during stratigraphic examination and from the pollen washings are listed in Table 1.

An examination of part of the root, the second part removed from the *in situ* stump, found it to contain twenty seven annual rings. The first five rings were narrow and showed little summer growth, these were followed by seven broader rings exhibiting an increase in summer growth, but the remaining fifteen rings were like the initial five, narrow and with little summer growth.

Pollen Diagrams

This can be divided into two sections; 250 to 100 cm is dominated by arboreal pollen and from 100 to 0 cm non-arboreal pollen is dominant. Closer examination allows further division into five zones which have subtler differences in their pollen ratios.

Table 1. Macrofossils recorded during stratigraphic examination and recovered from pollen washings.

Depth (cm)	Description of Macrofossil
7-8	Branches and stems of *Sphagnum papillosum*
18	*Calluna* twig
55-56	Burnt non arboreal fragments
60-75	Very large root, too large to remove without disrupting the core
82-83	Stems and three *Calluna* leaves, all burnt
94-95	Burnt unidentifiable fragments
100	Part of a Birch branch, *In situ* stump washed out of peat several metres from core site
104-105	*Juncus* seeds and *Eriophorum vaginatum* L. spindles
110-111	*Potentilla* seed
115-116	Burnt moss stems, *Juncus* and *Carex* fruits, bud scales of *Populus tremula* L. and fern sporangia
117-118	Bud scales, rare unidentified charcoal fragments
131-132	Burnt stems
156-157	Seeds, *Juncus* and *Potentilla*
166-167	*Juncus* seeds and large piece of *Salix* stem
175-176	Seeds and fruits of *Juncus, Carex* and *Potentilla*, mass of rotten squashed wood
182-183	Seeds of *Juncus* and fruits of *Potentilla*
190-191	Seeds and fruits of *Juncus, Potentilla* and *Carex*
195-196	Seeds *Juncus* and Birch twig
205	Small pebble
210	Unidentified wood (poorly preserved)
215	Unidentified wood (poorly preserved)
220-221	Mosses, mostly *Hylocomium splendens*, some *Polytrichum* stems and five leaves of *Sphagnum* section. *Sphagnum* (badly degraded cf. *palustre*)
250	*Hypnum cupressiforme* cf. *jutlandicum*

Local Pollen Assemblage Zone LS One 250-200 cm.

Zone one is dominated by arboreal pollen, the lowest value being 64% of Total Pollen and Spores (T.P.S.) at 235 cm, rising to a maximum of 75% between 227-206 cm. Although Scots Pine is present in all samples its maximum value of 4% T.P.S. at 235 cm, does not reach the 5% T.P.S. threshold required for evidence of on site presence (Fossitt, 1996; Bennett, 1996). NAP is represented by at least six angiosperm taxa and one pteridophyte. Amongst the angiosperms, Poaceae were the most important, being present throughout at between 7 and 12%. Cyperaceae were also important; although omnipresent they begin at low values rising towards the end to reach 13% at 220 cm. At 145 cm *Calluna* was present at 8% but in the rest of the zone it only reached 1%. Rosaceae were present at up to 8% and Asteraceae were present only at 235 cm, reaching 2%. Pteridophytes are represented by Filicales which reach 15% at 195 cm.

Local Pollen Assemblage LS Zone Two 220-160

Arboreal pollen begins this zone at 70% and rises to an all time high of 90% at 182 cm. This rise is short lived and by 166 cm arboreal pollen falls to its lowest value in the tree pollen dominated section at 38%. Scots Pine is scarcer than in zone one never exceeding 1% and is absent from one sample.

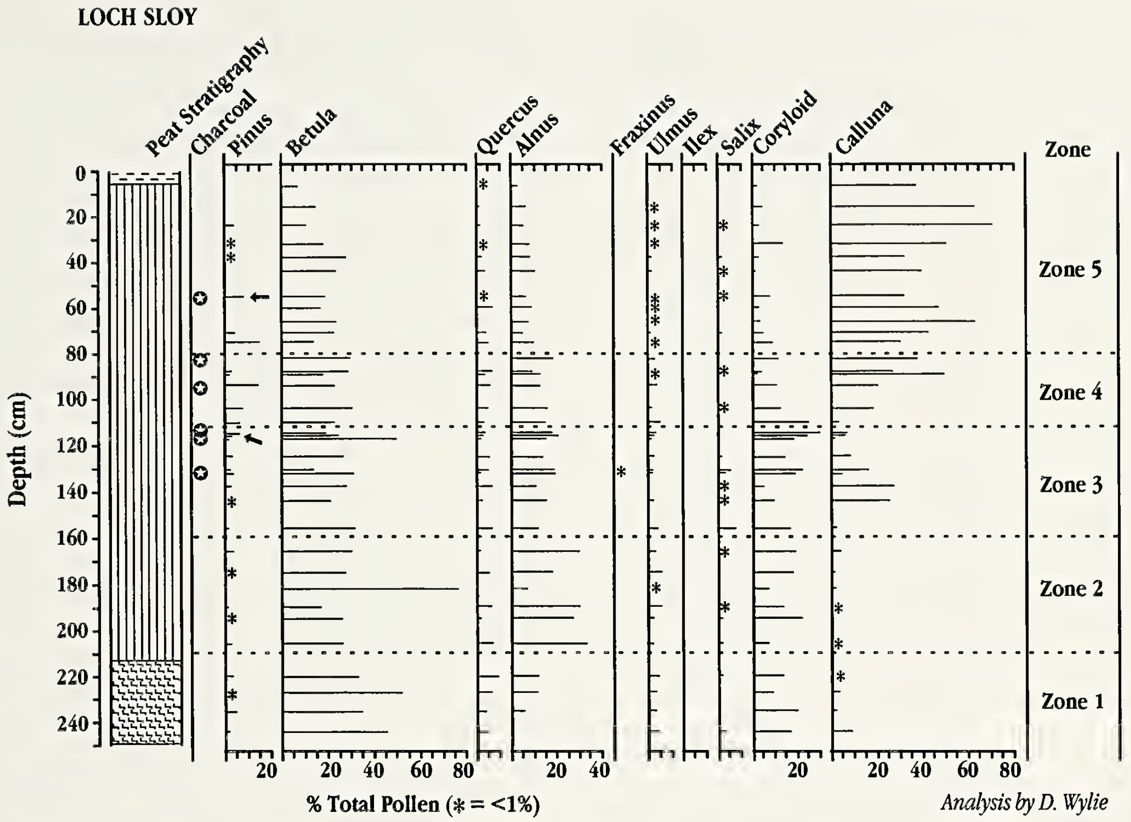

Figure 4. Pollen diagram showing the pollen of tree and tall shrub taxa which were included as arboreal pollen (AP). Also the pollen of Heaths which were included with the non-arboreal pollen (NAP). Circled stars indicate the presence of charcoal in samples removed for pollen analysis. Arrows indicate the first and last samples in which Pinus reaches 5% of total pollen.

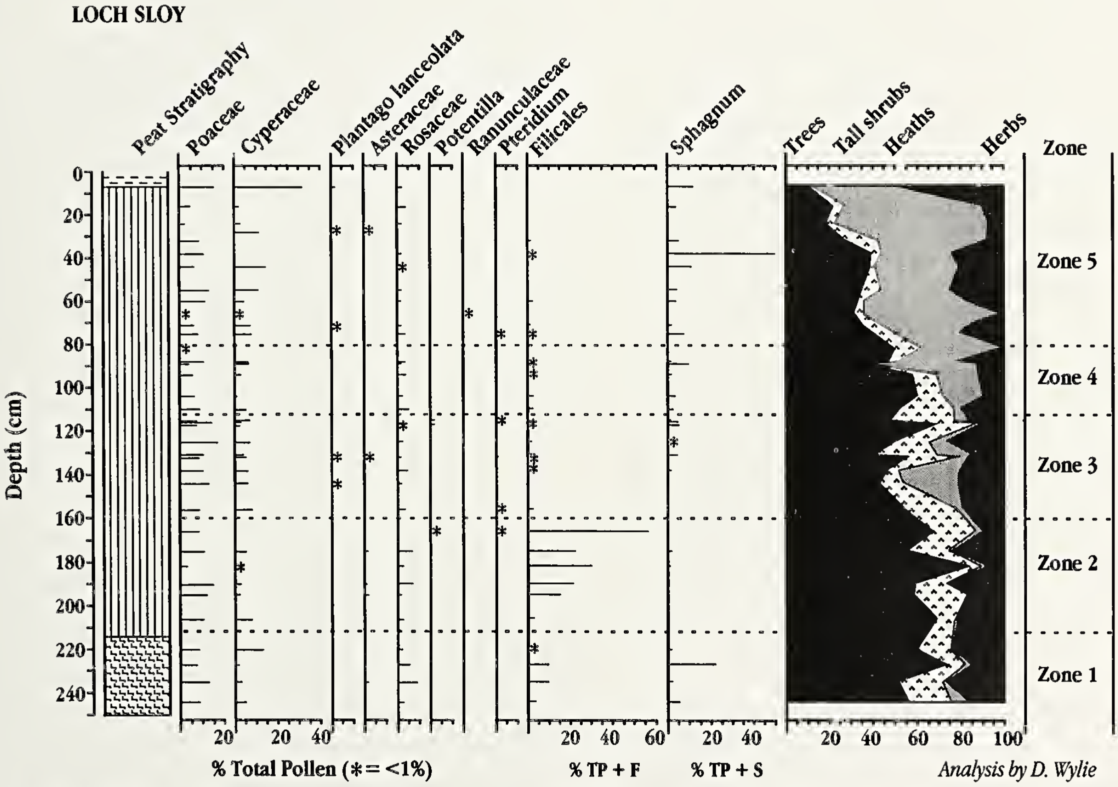

Figure 5. Pollen diagram showing the pollen and spores of non-arboreal taxa (NAP = non arboreal pollen) other than Heaths. To the right a summary diagram showing proportions of pollen of trees, tall shrubs (Coryloid = *Corylus* and/ or *Myrica*), heaths (*Calluna*) and herbs (all herbaceous plants).

NAP is low in taxa. Poaceae are well represented, Cyperaceae are present on three occasions always at below 4%, Rosaceae were in all levels and reached 7% on two occasions and *Calluna* was present also but not above 2%. *Pteridium*, Ranunculaceae and Asteraceae were all occasionally present at 1%. The most visible difference in this zone was in the pattern of Filicales spores. They rose from 15% at 195 cm to a peak of 32% at 156 cm but at 182 cm they then fell back to 23% before steeply rising to an all time high of 56% at 166 cm.

Local Pollen Assemblage Zone LS Three 160 - 112 cm

Arboreal pollen is still dominant here but there are now long periods during which this dominance is threatened by non arboreal species. At 170 cm arboreal pollen reaches its second highest value in the core, 87%. The four main tree species all undergo a series of rises and falls during this zone. Scots Pine values between 156 and 116 cm never rise above 3% but in the last level, 115 cm, Scots Pine reaches 6% breaking the 5% threshold required for evidence of on site presence. Again NAP is poor in taxa; *Plantago lanceolata*, *Pteridium aquilinum* and Asteraceae are present but only sporadically and do not exceed 1%, Rosaceae are present in all but one level with values up to 4%, Poaceae are present in all levels never falling below 7% and rising to a high of 17% at 130 cm. Cyperaceae are present in all levels, rising to 9% at 135 cm and only twice falling below 5% at 116 and 117 cm. Filicales are present in all but one sample but never rise above 5%. *Calluna* enters this zone at 3%, rises to 25% and by 148 cm it reaches 27%. It then follows a downward trend to as low as 2% at 117 cm, ending the zone on 5%.

Local Pollen Assemblage Zone LS Four 112-80 cm

This is the zone which sees the transition from arboreal to non-arboreal pollen dominance. It begins with arboreal pollen at 79%. This falls slowly at first reaching 71% at 94 cm, the last time arboreal pollen is this abundant. By 89 cm arboreal pollen has fallen to 37% but it rises again to end this zone on 62%. Scots Pine reaches threshold value in the first three levels rising to 14% at 94 cm, but in the next level it falls to 1% and at 82 cm Scots Pine is absent. Only four angiosperm taxa and one pteridophyte were recognised. From 3% at 110 cm *Calluna* rises to 48% at 89 cm but drops to 38% at 82 cm. Rosaceae falls over most of this zone from 6% at 110 cm until it is absent at 82 cm. Poaceae and Cyperaceae values fluctuate throughout this zone, the former never below 3% or above 9%, the later ranging from 1% to 8% except in level 82 cm from which it is absent. Filicales are sporadically present at between 1 and 3%.

Local Pollen Assemblage Zone LS Five 80-0 cm

At 75 cm arboreal pollen is 50%. In all subsequent levels it is below this and drops eventually to 12%; between this it falls to 36% at 60 cm and 22% at 24 cm, but recovers after each before the final decline. Scots Pine is present above threshold level in three samples; at 75 cm it reaches 14%, at 60 cm 9% and at 55 cm 8% but it drops to 3% at 71 cm and is absent at 66 cm, where it reaches 3%. Two waves of *Calluna* in this zone are separated by a trough. The waves centre on 66 and 32 cm where values are 63% and 50% respectively. The lowest value is the initial reading of 29% and the final value of 37% comes at a period of decreasing *Calluna*. Eight other families were present in the field layer. Poaceae are in most levels. They show no pattern but rise to 15% at 7 cm. Cyperaceae have a high of 31% at 7 cm, but otherwise do not rise above 14% and are absent in parts of the zone. Rosaceae are usually present but only once above 5%. Filicales were present in less than half of the levels never rising above 2%. *Plantago lanceolata*, *Pteridium*, Ranunculaceae and Asteraceae were present but at less than 2% and only in occasional samples.

The Present Pollen Rain

Table 2 shows the species composition percentage cover and percentage pollen and spores from a 10 x 10m sample quadrat taken from the site.

Pollen presently being deposited is dominated by Poaceae which comprised 67% of all the pollen and spores, more than double the sum of all other taxa combined. Other pollen types included Birch 7%, Alder 6%, *Calluna* 4%, Rosaceae 3%, Cyperaceae 2%, and Asteraceae 1%. The dominance of Birch has waned, as has the importance of Coryloid, which was absent from the surface sample, while Alder and Scots Pine have remained unchanged. The losses incurred by Birch and Coryloid have been to the benefit of Oak, which at 4% is at a level rarely attained in the last 4000 years, and three other genera which are present for the first time namely *Picea* sp. 3%. *Tilia* sp 1% and *Acer* sp 1%. These changes are easily explained by the activities of man in the last 500 years. During this time he has planted Oak and introduced *Tilia* as ornamental or amenity trees; *Acer pseudoplatanus* has also been introduced, it is grown widely in shelter belts and now regenerates freely. There has also been large scale afforestation with monocultures of alien conifers including *Picea abies* and *P. stichensis* (Norway and Sitka Spruce). At the same time as these introductions increased grazing and land improvement have lead to a reduction in natural forest. Oak woods have been less affected than others as they are often managed under coppice and standard system.

DISCUSSION

When the vegetation represented by the peat at the base of the core was alive the area around what is now Loch Sloy had a canopy dominated by Birch with some Oak, Elm and a little Alder. There was an understorey of Hazel and a field layer in which grew mosses, Poaceae, Cyperaceae, Rosaceae, *Calluna* and some Filicales. The increasing values of Alder in zones one and two are taken to represent the Holocene rise of this tree which began about 7400 years ago. If this is correct, the lowest sample examined came from peat which had begun to form well into the Holocene epoch, perhaps as much as 8000 or more years ago. Other features near the base are consistent

Table 2. Species composition, % cover and % pollen and spores recorded from a 10x10mm sample quadrat at the site.

Species/Family	% Cover	% Pollen and Spores
Molinia caerulea	40	0
Agrostis sp.	15	0
Anthoxanthum odoratum	5	0
Festuca sp.	2	0
Total Poaceae	62%	67%
Sphagnum	20	0
Polytrichum	20	0
Viola palustris	>10	0
Galium saxatile	5	0
Potentilla erecta	5	0
Total Rosaceae	5%	2%
Polygala serpylofolia	<5	0
Prunella vulgaris	<5	0
Salix aurita	<5	0
Cirsium palustris	2 seedlings	0
Leontodon autumnalis	2	0
Total Asteraceae	>2%	1%
Calluna	+	4
Pedicularis sp	+	0
Ranunculus acris	+	0
Ranunculus flammula	+	0
Total Ranunculaceae	+	0%
Carex echinata	+	0
Eriophorum angustifolium	<5	0
Total Cyperaceae	5%	3%
Juncus bulbosus	+	0
Juncus acutiflorus	2	0
Total Juncaceae	>2%	0%
Total Non-arboreal Pollen	na	67%
Betula spp.	0	7
Alnus glutinosa	0	6
Quercus sp.	0	3
Picea sp.	0	3
Pinus sylvestris	0	2
Acer pseudoplatanus	0	1
Tilia sp.	0	1
Total Tree Pollen	na	23%

with the known vegetational history of this period; Birch was the forest dominant in this area having displaced the coloniser species, such as the dwarf shrubs e.g. *Salix herbacea* (Dwarf Willow) and *Betula nana* (Dwarf Birch) as well as Poaceae and Cyperaceae, all of which flourished in late-glacial times. The predominance of Birch which is a heavy pollen producer, may be responsible for an under-representation or absence of some taxa.

Towards the end of pollen zone one the peat changes to stratum B type peat, and Alder pollen values rise at the expense of Birch and Coryloid values. On either side of the peat stratum boundary wood macrofossils are numerous proving the immediate presence of trees or shrubs.

Pollen zone two is characterised by a profusion of Filicales spores, with other important pollen types including Birch, Alder, Coryloid, Poaceae and Rosaceae. Significant macrofossils, apart from wood, included seeds and fruits particularly of *Juncus, Potentilla* and *Carex*. The quantity of *Juncus* seeds is important as the pollen of this genus is very rarely preserved. The pollen and macrofossil assemblage present indicates that at this time the site was occupied by an Alder carr.

In pollen zones three and four there are several interesting occurrences. Although still within stratum B, the amount of macroscopic wood fragments has diminished but macroscopic fossils of *Juncus, Potentilla* and *Carex* are still common. Pollen types important in zone three include Birch, Coryloid and Alder amongst the trees with some Oak and Elm. The non arboreal flora contained Poaceae, Cyperaceae and Rosaceae with *Calluna* becoming abundant for a period; some Filicales are present and *Sphagnum* begins to increase at this time. This indicates a change to peat containing minor amounts of Poaceae, Cyperaceae, *Calluna* and *Sphagnum*. Although the Alder rise is very obvious, evidence for the Elm decline is not as readily apparent. In Holocene pollen diagrams from throughout Britain there is often to be seen easily a marked drop in Elm pollen values which has been radiocarbon dated many times to about 5700-5800 years ago.

The end of zone three, which may have been about 5000 years ago, is a significant period in the history of the Loch Sloy area. Scots Pine pollen then increased to above the threshold value of 5% for the first time (see lower arrow in Figure 4) and continued to rise over much of zone four, before almost disappearing for the first time at level 89 cm. Before this time, the Scots Pine pollen present had probably been wind-dispersed from other areas. The beginning of zone four is the period during which the dated Scots Pine stump was alive. Pollen zone four sees *Calluna* rise to dominance at the expense of most other species except Oak and Rosaceae. Elm all but disappears near the end of this zone.

In pollen zone five there are no macroscopic seed remains and only one piece of unidentifiable woody material, although a few macroscopic remains of *Calluna* and *Sphagnum* are present. The pollen of *Calluna* now dominates all others, although Poaceae and Cyperaceae are still relatively abundant till about the middle of the zone. The topmost 6 cm of the core constitute peat stratum C. Scots Pine has two peaks in this zone including a return to its maximum value of 14% and its final greater than threshold value of 7% (see upper arrow Figure 4) but it is again missing from the levels between these peaks. In the topmost six levels Scots Pine did not reach threshold values and, over what is perhaps the last 3000 years, the pollen was wind-borne to the site.

The six fires known to have occurred during the time spanned by the core are contained within pollen zones three to five, as are the high Scots Pine values. The fires began before about 5000 years ago, well within the time of Neolithic people, the first agriculturalists, and consequently may be anthropogenic. Burning appears to precede or coincide with increases in Scots Pine values and occurs simultaneously with two of the three population crashes. It seems very likely that there is some relationship between Scots Pine and burning, as suggested by Durno and McVean (1959). This may mean that fire was the agent responsible for the establishment and perhaps destruction of Scots Pine at Loch Sloy.

It is possible that the effects of the fires reduced or eliminated whatever factor or factors may have been responsible for any inhibition of the spread of Scots Pine seedlings onto the *Calluna*-dominated bog. The fires may have removed sufficient ground cover, destroyed an allelopathic agent or sufficiently dried the bog surface to allow the establishment of Scots Pine. The trees may have established at a time when the climate was becoming more oceanic; this wetness could have meant that the intervention of man was required to instigate the fires. It is suggested, however, that periods may have occurred when it was sufficiently dry to allow natural fires even at this time (McVean, 1964). Further analysis using, for example, contiguous sampling would be required to test these theories.

Rather than intermittent presence, an alternative theory is that Scots Pine may have been present on the site continuously since it first arrived during a dry period. If the climate was to deteriorate, blanket peat could have begun to spread. The wood sample taken from the Scots Pine stump showed very little summer growth even over the seven years of apparently improved growth. This indicates a tree growing under conditions of stress, possibly induced by the wetness of the bog surface. Under such conditions of high stress the tree would struggle to survive and would have produced little if any pollen. In intervening drier years pollen production could increase, as would the width of annual growth rings. This would explain the lack of Scots Pine pollen in the levels between the high values.

Elm pollen values never exceed 5% at Loch Sloy. Occurring as it did about 5400-5800 years ago the Elm decline must lie between the level of the Scots Pine stump and the base of the core. The diagram reveals three levels in which Elm values decrease, 206, 182 and 166 cm but the values return to elevated levels within the next two samples. However, the fall beginning at 144 cm does not recover over seven samples until 110 cm after which it collapses again and reaches only trace amounts for the rest of the core. The depth of 144 cm is the most likely to represent the Elm decline.

Three other cores from the Loch Lomond area have been examined in the recent past and their results can be compared to the findings from Loch Sloy. The cores are from: Ptarmigan (National Grid NN 365 015), a high altitude site 15 km south-east of Loch Sloy on the south-west subsidiary top of Ben Lomond at 500 m, with a south-easterly aspect. Shantron Muir (NS 328 878) lies 26 km to the south at 350 m with a northern aspect. Glen Falloch (NN 369 238) 12 km to the north-east at an altitude of 150 m on a south-east aspect. All were examined by Stewart (1979). Only the Glen Falloch site makes a valuable comparison.

Stewart's analysis from Glen Falloch shows remarkable parallels to Loch Sloy. The peat is not deep enough to include the Elm decline and so nothing is known of the history before 5700 years ago. At about 4850 years ago Birch was dominant and Scots Pine was present only as wind borne pollen and Alder values, unlike at Loch Sloy, were low. Dated sediment cores from Loch Lomond confirmed the spread of Scots Pine in the area about 4750 years ago. As at Loch Sloy, Scots Pine colonised *Calluna* peat, the dryness of which is attributed to favourable local conditions. Glen Falloch also shows many episodes of burning, which Stewart (1979) attributes to Neolithic man. He postulates that these events were critical in the spread of Scots Pine in Glen Falloch. A carbon-dated stump is evidence that Scots Pine grew there about 1600 years ago and it is thought that the present sparse Scots Pine trees are a disjunct population of the original native Pinewood which had been present since about 5100 years ago.

Scots Pine in the Loch Sloy area has had a complex history. If the deduced chronology is correct, then Scots Pine was present for very approximately the 2000 years between about 5000 and 3000 years ago. Any further precision in chronology can only come from radiocarbon dating of the peat. The tree arrived at the Loch Sloy site about 5000 years ago to grow on peat composed of Poaceae, Cyperaceae and *Calluna*, perhaps rendered suitable for Scots Pine colonisation by the action of fire. It invaded a community dominated by Hazel and Birch with a field layer of Poaceae, Cyperaceae and *Calluna*. Finally it vacated the Loch Sloy area about 3000 years ago. During its period of residence both the community composition and the type of peat changed. The dominance of the trees was broken, and although Poaceae and Cyperaceae usually remained at similar levels to before, they and all other taxa were swamped by the huge rise in *Calluna*. This change affected the composition of the peat which became dominated by *Calluna* with some Poaceae, Cyperaceae and *Sphagnum*.

The Scots Pine pollen levels fluctuated greatly over time; from being the dominant tree species at one point it disappears from the pollen record at others. The reason for these marked changes depends upon which theory is correct, withdrawals from the site or poor growth and flowering under stressful conditions.

Parallels with Scots Pine at Glen Falloch are striking. At both sites it invades Heather peat at about the same time and in both cases the occurrences of fire are attested by charcoal. Although Scots Pine disappeared from Loch Sloy it stubbornly clings to the Glen Falloch site, presently its most southerly natural outpost. Possibly the return to more oceanic conditions prevented the recolonisation of Loch Sloy by Scots Pine due to the altitude of the site, which is 140 m higher than Glen Falloch.

The occurrence of fires has been cited by many researchers as being responsible for preparing peaty substrata for colonisation by Scots Pine and also for the destruction of the woodlands after establishment. Birks (1975) relates the action of fire to the establishment and destruction of pinewood at Cooran Lane and Coire Bog respectively, Durno and McVean (1959) relate a similar story at Beinn Eighe while Gear and Huntley (1991) report of fire before during and after a period of Scots Pine growth in Caithness and Sutherland.

That Scots Pine spread onto the slopes of Loch Sloy about 5000 years ago and vacated the area some 2000 or so years later is consistent with the main statements by Bennett (1994) as related in the introduction. The findings of coarse charcoal in samples straddling the period of maximum *Pinus* pollen strongly suggests that recurrent fires were an important factor in controlling the growth of Scots Pine on the blanket peat at Loch Sloy.

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WHALE-LICE (AMPHIPODA: CYAMIDAE) AND SEA LICE (COPEPODA: CALIGIDAE) FROM STRANDED WHALES IN THE FIRTH OF FORTH

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The Cyamidae is a family of amphipod crustaceans adapted as ectoparasites of cetaceans, hence their common name of whale-lice. Although relatively large, on account of their peculiar habitat, they are a rather poorly studied group. New species are still being discovered even within British waters (Lincoln & Hurley, 1974a) and much remains to be learned about their ecology and phylogeny. The distribution of the various whale-lice species between different species of whale and dolphin may provide some clues regarding the co-evolution of cetaceans and their parasites (Avdeev, 1990).

Copepod crustaceans, on the other hand, are well known as "Sea Lice" or "Gill Maggots" parasitising many types of fish but to date only two species have been associated with whales.

The stranding of two uncommon whale species in the Firth of Forth within recent years has provided an opportunity to collect new material of their crustacean ectoparasites.

In October 1988, a Bottle-nosed Whale, *Hyperoodon ampullatus* (Forster, 1770), was stranded at Culross (Kitchener, 1989). The whale, a female about 6 m long, was lying on its side and appeared to have only recently died. The body was examined by the author and was found to have two whale-lice and two sea lice on its exposed flanks. The whale-lice, 3.5 and 3.6 mm long (excluding antennae) were both identified, using Leung (1967), as male *Platcyamus thompsoni* (Gosse, 1855), (Fig. 1). The sea lice, 4.0 and 4.5 mm long (excluding furcal setae), comprised a male and female *Caligus elongatus* Nordmann, 1832 (Fig. 2).

In March 1997, a Sperm Whale (*Physeter catodon* Linnaeus, 1758) entered the Forth Estuary and seemed unable to find its way back out to deeper water. The whale, an adult male, was observed in several localities over a period of 12 days and its plight aroused considerable media attention (eg. The Herald newspaper, 31/3/97). It eventually became stranded at Airth and subsequently died. The body was examined by scientists from the National Museum of Scotland (Kitchener, 1997) and from Deep Sea World (North Queensferry). Hundreds of whale-lice were observed around the anal vent area and a sample of ten of these were removed and sent to the author for identification. They ranged in size from 5.0 to 6.9 mm (excluding antennae) and consisted of seven female and three male *Cyamus catodontis* Margolis, 1954, (Fig. 3).

Both the above whale-lice species have been rarely recorded in UK waters. In his redescription of *Platycyamus thompsoni*, Wolff (1958) gives its distribution as England (type locality), Denmark, the Faroes and Spitzbergen although he recognises that its only known host, the Bottle-nosed Whale, has a much wider distribution. Stock (1973) highlights additional material collected in Dutch waters in 1931 but overlooked in Wolff's study. In their review of cyamid material held at the British Museum, Lincoln & Hurley (1974b) cite further specimens from the Norman Collection and also from University College, Dundee but no locality data are available for these. Stranding of Bottle-nosed Whales in the Forth area are summarised by Maclaren (1981) and undoubtedly many of these carried whale-lice. The whale-lice described as "*Cyanus* sp." by Maclaren, removed from a Bottle-nosed Whale stranded at Skinflats, Grangemouth in 1981 (and held at the National Museum of Scotland, NMSZ 1981.30) are most probably *P. thompsoni*. The new material, however, appears to represent the first confirmed record of *P. thompsoni* from Scottish waters.

Four, or possibly five, whale-lice species are known to infest Sperm Whales (Avdeev, 1990). Stock (1973) records *C. catodontis* for the first time in North West European seas and comments on the confusion between some of the species associated with Sperm Whales. The new find apparently represents the first record of *C. catodontis* within UK waters proper.

The occurrence of the copepod *C. elongatus* on a whale is of interest. In his synopsis of copepods associated with marine invertebrates (and whales), Gotto (1993) cites only the harpacticoid *Balaenophilus unisetus* Aurivillius, 1879 which lives among the plates of baleen whales. Several species of the siphonostomatoid genus *Pennella* have also been recorded as parasites of whales though it is now recognised (Hogens, 1987) that all those from cetaceans are probably variants of a single species, *Pennella balaenoptera* Koren & Danielsson, 1877. This species, the largest known copepod, up to 32 cm long, has in fact been recorded in UK waters from a Fin Whale landed at Shetland (Turner, 1905), off St Kilda (Leigh-Sharpe, 1928) and also from a Minke Whale off Tynemouth in 1948 (see Bossanyi & Bull, 1971). In 1855 a Bottle-nosed Whale captured south of the Faroes harboured a *Pennella* which probably refers to the same species (see Turner, 1905).

The presence of *C. elongatus* on a Bottle-nosed Whale is not entirely surprising. According to Kabata (1979) it is probably the most common parasitic copepod in British waters where it infests nearly forty fish species. Caligids have been recorded attaching to a diverse range of vertebrate hosts, including humans, as well as infestations of some invertebrates

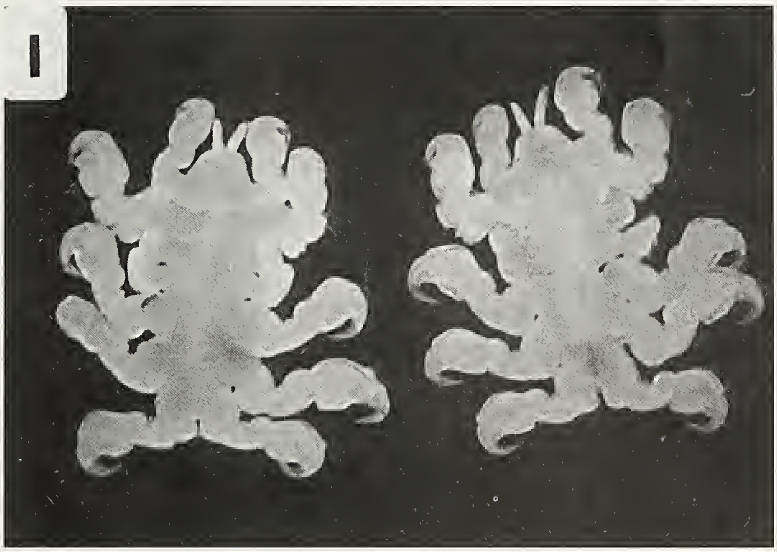

Figure 1. Video print of two male *Platycyamus thompsoni*.

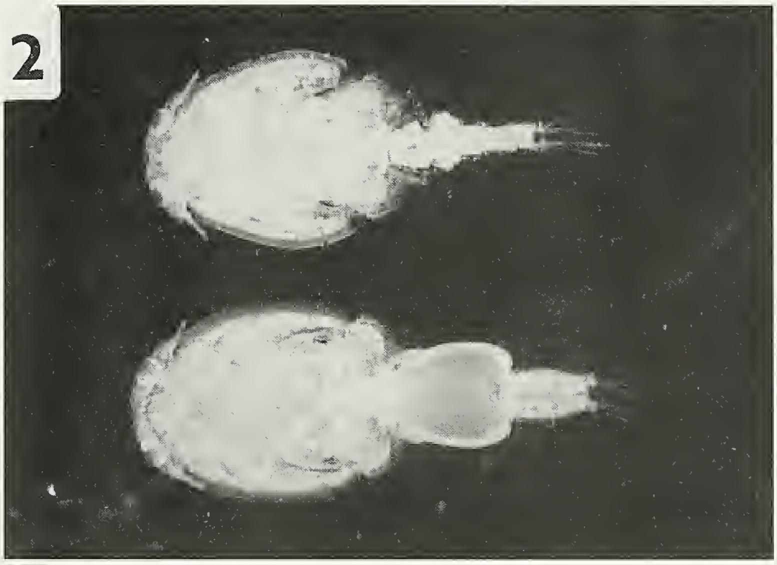

Figure 2. Video print of male (above) and female (below) *Caligus elongatus*.

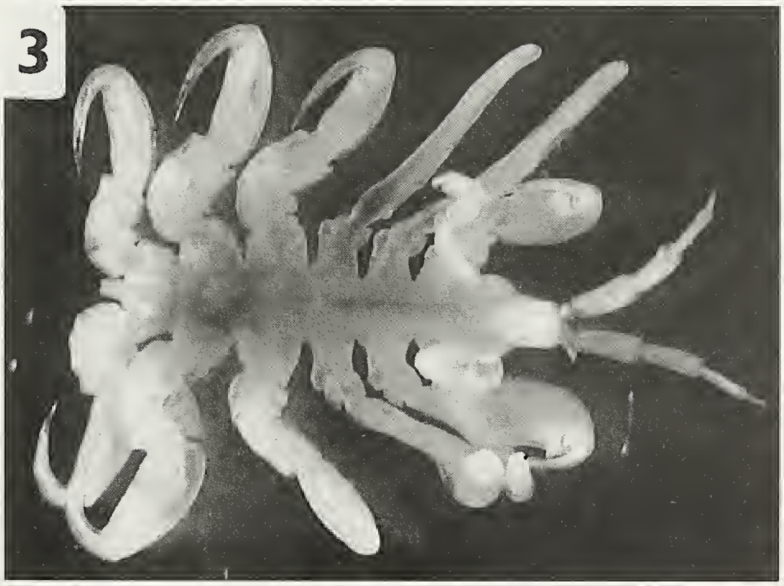

Figure 3. Video print of a male *Cyamus catodontis,* ventral view.

such as farmed shrimps (Ruangpan & Kabata, 1984). Anecdotal accounts also exist of sea lice attaching to commercial divers operating in the North Sea (Cleator, pers. comm.). The new record brings to three the number of copepod species now known to be associated with whales.

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SCOTTISH INSECT RECORDS FOR 1996

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The aim of this compilation is to bring together records as submitted by active field workers in Scotland. The number of records from the southwest of the country are the result of the annual field meeting of Scottish entomologists held in the area in June 1996. Contributions from areas that may not have received much attention in recent years are particularly welcome such as those reproduced below from Orkney. Often such records may appear to be of species generally regarded as common and widespread but which, for example, fill blanks on current mapping schemes where such exist. Not all the contributors are necessarily domiciled in Scotland and visits from holidaymakers serve the same purpose where there are no resident naturalists. The compiler would like to draw attention to a correction to last year's list which is dealt with under the relevant species. In the following list, specific names of Lepidoptera are as in Kloet & Hincks (1972) and the reference numbers are as in Bradley & Fletcher (1979) and as these entries are numbered, family names have been omitted. Other insects are given as in Kloet & Hincks (1964, 1976, 1977, 1978).

ODONATA

COENAGRIIDAE

Pyrrhosoma nymphula (Sulzer), Large Red Damselfly. Newhouse, Hourston, Dounby, Orkney (HY290203), V.C.111, 9/6/96, JH.

Ischnura elegans (van der Linden), Blue-tailed Damselfly. Cruland, Yescanaby, Orkney (HY240151), V.C.111, 20/6/96, JH. Rose-coloured and green form females seen at the same site.

CALOPTERYGIDAE

Calopteryx virgo (L.) Beautiful Demoiselle. Grasspoint, Mull, 6 individuals seen (NM610247), V.C.103, 27/6/96, AAJ. This damselfy was recorded here last year and the area is clearly a local stronghold for the species.

CORDULIIDAE

Somatochlora metallica (van der Linden). Loch an Airigh Fhraoich, (NH3338), V.C.96, 23/7/97, SM. Single female seen ovipositing.

LIBELLULIDAE

Orthetrum coerulescens (Fabr.) Keeled Skimmer. Lochbuie, Mull, 1 individual seen (NM610247), V.C.103, 22/6/96; Turramana Loch, Colonsay, 5 adults seen (NR392955), V.C.102, 4/6/96, AAJ.

Libellula quadrimaculata L. Four-spotted Chaser. Lochbuie, Mull, 1 individual seen (NM610247), V.C. 103, 22/6/96, AAJ.

NEUROPTERA

CHRYSOPIDAE

Chrysopa perla (L.). This species was incorrectly rendered during last year's compilation and should read *Chrysoperla carnea* (Stephens), Upper Aird, Lewis, one male in outhouse (NB5536), V.C.110, 8/10/95.

HEMIPTERA HETEROPTERA

ARADIDAE

Aradus betulae (L.). Glen Cannich, Inverness (NH2933), V.C.96, 18/5/96, SH; Granton-on-Spey (NJ0326), V.C.95, 19/5/96, EGH.

ACANTHOSOMATIDAE

Acanthosoma haemorrhoidale (L.). Lochan Càrn a' Chuilinn (alt. 900m) dead specimen from stomach of *Salmo trutta* (NH4403), V.C.96, 26/6/96, JW, (det SM); Ord, Skye,(NG6113), V.C.104, 7/11/96, MB & AC, (det SM).

CIMICIDAE

Cimex lectularius L. Nethy Bridge, house infestation (NJ02), V.C.95,9/96, RE.

LYGAEIDAE

Eremecoris abietis (L.). Lochloy Wood, under driftwood resting on *Empetrum nigrum* (NH9359), V.C.96, 21/9/96, SM.

E. plebejus (Fallén). Lochloy Wood, 1 adult found in pine needle litter at edge of plantation (NH9359), V.C.96, 21/9/96, SM; Mains of Faillie, 1 adult & 1 last instar nymph found in litter on boulder beneath a Scots pine, isolated within a Douglas fir plantation (NH7037), V.C.96, 15/9/96, SM.

MIRIDAE

Bothynotus pilosus (Boheman). Drakies, Inverness, male in actinic light trap in garden (NH683441), V.C.96, 20/8/96, SM.

Orthotylus fuscescens (Kirschbaum). Daviot Wood, beaten from Scots pine (NH7040), V.C.96, 7/8/96, SM.

Stenotus binotatus (Fabr.). Cannich, swept from herb-rich grassland on river terrace (NH3431), V.C.96, 31/7/96, SM.

Trigonotylus psammaecolor Reuter. Old Bar, Culbin, marram on foredunes (NH9562), V.C.95, 10/7/96, SM.

LEPIDOPTERA

162 *Cossus cossus* (L.) Goat Moth. Balgate, Kiltarlity, one female to light in house (NH509418), V.C.96, 7/8/96, JC, (det. SM).

371 *Sesia bembeciformis* (Hübn.) Lunar Hornet Moth. Kirkibost, Strathaird, Skye, flying near Salix sp. (NG548173), V.C.104, 21/7/96, SM.

1074 *Olethreutes palustrana* (Lien. & Zeller). Daviot Wood, flying above Calluna (NH7040), V.C.96, 5/8/96, SM.

1545 *Colias croceus* (Geoffroy in Fourcroy) Clouded Yellow. Rascarrel Bay (NX811483), V.C.73, 8/6/96, AD; Ingram Street, Glasgow (NS5965), V.C.77, 18/7/96, BS; Rockcliffe (NX8553), V.C.73, 3/9/96, R&BM.

1553 *Anthocharis cardamines* (L.) Orange Tip. Auchindrain Museum, (NN031032), V.C.98, 27/5/96, RW.

1557 *Quercusia quercus* (L.) Purple Hairstreak.

Drumlochlan Wood, Comrie (NN752227), V.C.88, 10/8/96, RS; East Lodge, Dunira, Comrie (NN753228), V.C.88, 10/8/96, RS; Twenty Shillings Wood, Comrie (NN7622), V.C.88, 8/96, AMS; Craig Wood (NX1482), V.C.75, 8/96, JPB.

1573 *Aricia artaxerxes* (Fabr.) Northern Brown Argus. Thankerton (NS994377), V.C.77, 21/7/96, DG.

1590 *Vanessa atalanta* (L.) Red Admiral. Common throughout much of Scotland in 1996. Earliest record 1/6/96, latest record 27/10/96, RS.

1591 *Cynthia cardui* (L.) Painted Lady. Extremely plentiful, 1996 being a 'Painted Lady Year'. Examples seen throughout Scotland, with several reaching Orkney and Shetland. Earliest record 30/5/96, latest record 18/10/96, RS.

1596 *Nymphalis antiopa* (L.) Camberwell Beauty. Moine Mhor Nature Reserve, seen actively flying (NR826959), V.C.98, 15/5/96. JH; near Munlochy (NH653527), V.C.106, 21/5/96, ICM.

1597 *Inachis io* (L.) The Peacock. A notable influx of this species, with many records coming from the Central Belt, southern Ayrshire, Dumfries and Galloway and a few records from the Borders. Earliest record 16/4/96, latest record 6/11/96, RS.

1598 *Polygonia c-album* (L.) The Comma. Chesters (NT627108). V.C.80, 26/10/96, DS.

1600 *Boloria selene* (Denis & Schiffermüller) Small Pearl-bordered Fritillary. Lochbuie (NM610247), 22/6/96; Grasspoint (NM734304), 27/6/96; Portfield (NM717260), 23/6/96; Carsaig, Mull (NM544215), 24/6/96, AAJ, all V.C.103.

1628 *Coenonympha tullia* (Müll.) Large Heath. Cander Moss (NS782462), V.C.77, 2/7/96-24/7/96, AKM; Balgray Reservoir, (NS5156), V.C.76, 25/6/96-28/6/96, JW.

1643 *Saturnia pavonia* (L.) Emperor Moth. Kintour, Islay, in Heath-type light trap (NR461519), V.C.102 10/5/96, RG.

1752 *Cosmorhoe ocellata* (L.) Purple Bar. Kintour, Islay, in Heath-type light trap (NR461519), V.C.102, 8-12/5/96, RG.

1775 *Colostygia multistrigaria* (Howarth) Mottled Grey. Kintour, Islay, in Heath-type light trap (NR461519), V.C.102, 10-15/5/96, RG.

1865 *Chesias rufata scotica* Rich. Broom-tip. Kingsteps, trapped at actinic light, edge of conifer plantation (NH9157), V.C.96, 26/7/96, SM.

1972 *Agrius convolvuli* (L.) Convolvulus Hawk-moth. Bonar Bridge (NH6191), V.C.107, 28/8/96, PFE; Inverness (NH645454), V.C.96, 30/8/96, NM, (det.SM); Morayston (NH742489), V.C.96, 31/8/96, TA; Alness (NH656701), V.C.106, 8/9/96, GBT, (det. SM); Durness (NC403677), V.C.108, 9/9/96, UR; Aigas, Strathglass (NH44), V.C.96, summer, 1996, AM.

2103 *Eugnorisma depuncta* (L.), Plain Clay. Cannich, actinic light trap (NH3431), V.C.96, 30/7/96, SM.

2243 *Xylocampa areola* (Esper). Early Grey. Kintour, Islay, in Heath-type light trap (NR461519), V.C.102, 8-12/5/96, RG.

2281 *Acronicta alni* (L.) Alder Moth. Closeburn, south of Thornhill, Dumfries, V.C.72, 8/96, MM.

COLEOPTERA

CARABIDAE

Blethisa multipunctata (L.). Lillie's Loch, Kirkcudbrights. (NX517746), V.C.73, 23/6/96, RM.

Harpalus tardus (Panzer). Yellow Craig, East Lothian, one male under stone (NT516858), V.C.82, 23/5/96, MS.

DYTISCIDAE

Hydroporus ferrugineus Stephens. Northeast of Loch Sgamhain, Ross & Cromarty (NH111534), V.C.105, 1996, MDE.

H. obsoletus Aubé. Tarras Valley, Dumfries (NY3986), V.C.72, 6/96, MLL; River Ayr, Limmerhaugh (NS630272), V.C.75, 26/6/96, BV.

Graptodytes granularis (L.). Kings Laggan fen, Ardwall Hill, Kirkcudbrights.(NX567576), V.C.73 22/6/96, GNF.

Deronectes latus (Stephens). Gass Water, Cronberry, Ayrshire (NS6022), V.C.75, 21/6/96, BAN; House of Water (NS557126), V.C.75, 1996, MDE.

HYDROPHILIDAE

Georissus crenulatus (Rossi). River Ayr, Limmerhaugh (NS630272), V.C.75, 26/6/96, BV.

Hydrochus brevis (Herbst). Loch Lurkie, Kirkcudbrights.(NX728707), V.C.73, 24/6/96, RM.

Sphaeridium marginatum (Fabr.). Milton Loch, Kirkcudbrights., swept from waterside vegetation (NX842710), V.C.73, 24/6/96, MS; near Innerwick, East Lothian, in cow dung (NT7070), V.C.82, 17/8/96, BS (det. MS). This species was formerly regarded as a variety of *S. bipustulatum* (Fabr.) (see Hodge & Jones, 1995).

Paracymus scutellaris (Rosenhauer). Skerray, Sutherland (NC678624), V.C.108, 19/6/96, IR.

Anacaena limbata s.str.(Fabr.). Drummoral Pool, Isle of Whithorn, Wigtownshire (NX4635), V.C.74, 24/6/96, BV.

Helochares punctatus Sharp. Kings Laggan fen, Ardwall Hill (NX567576), V.C.73, 22/6/96, GNF. Due to earlier confusion with closely related species this is now in the British list (see Hodge & Jones, 1995).

HISTERIDAE

Gnathoncus nanus (Scriba). Yellow Craig, East Lothian, one female under dead guillemot (NT516858), V.C.82, 23/5/96, MS.

SILPHIDAE

Aclypea opaca (L.). Towford, Roxburghs., in a decaying lamb carcase (NT761134) V.C.80, 13/6/96, MS.

STAPHYLINIDAE

Stenus niveus Fauvel. near Innerwick, East Lothian, one female by general sweeping (NT7070), V.C.82, 17/8/96, MS.

HYDRAENIDAE

Ochthebius exsculptus Germar. River Ayr, Limmerhaugh (NS630272), V.C.75, 26/6/96, BV.

Hydraena pygmaea Waterhouse, G.R. Urr Water, Corsock (NX7675), V.C.73, 21/6/96, BV.

H. rufipes Curtis. Water of Ae, near Ae village (NX9988), V.C.72, 27/6/96, BV.

SCARABAEIDAE

Trichius fasciatus (L.). Cannich, Inverness (NH3431), V.C.96, 31/7/96, SM.

SCIRTIDAE

Hydrocyphon deflexicollis (Müller). Water of Ken (NX619602), V.C.73, 23/6/96, DAF; Spey Bridge, Newtonmore (NN706976), V.C.96, 1996, MDE.

ELMIDAE

Riolus cupreus (Müller, P.W.J.). River Ayr, Limmerhaugh (NS630272), V.C.75, 26/6/96, BV.

LYMEXYLIDAE

Hylecoetus dermestoides (L.). Glen Cannich, Inverness (NH2933), V.C.96, 18/6/96, EGH. Emerging in numbers from large cut spruce logs in all three colour variants - black, yellow and black and yellow.

CERAMBYCIDAE

Acanthocinus aedilis (L.) Grantown-on Spey, one male (NJ035283), V.C.95, 9/5/96, JWS.

CHRYSOMELIDAE

Macroplea appendiculata (Panzer). Milton Loch, Kirkcudbrights. (NX841710), V.C.73, 24/6/96, RM.

Donacia crassipes Fabr. Dow Lochs, Wood of Cree, Kirkcudbrights. (NX375717), V.C.73, 25/6/96, RM.

D. obscura Gyllenhal. Lillie's Loch (NX517746), V.C.73, 23/6/96, RM.

D. simplex Fabr. Kings Laggan fen, Ardwall Hill (NX567576), V.C.73, 22/6/96, RM; Loch Lurkie (NX728707), V.C.73, 24/6/96, RM.

D. thalassina Germar. Dow Lochs, Wood of Cree (NX375717), V.C.73, 25/6/96, RM; Loch Lurkie (NX728707), V.C.73, 24/6/96, RM.

Plateumaris affinis (Kunze). Dow Lochs, Wood of Cree (NX375717), V.C.73, 25/6/96, KM.

Clytra quadripunctata (L.). Culbin Forest, Moray (NH9760), V.C.95, 13/7/96, SM.

Hippuriphila modeeri (L.). House of Water, Ayrshire (NS557126), V.C.75, 1996, MDE.

CURCULIONIDAE

Otiorhynchus desertus Rosenhauer. John Muir Park, Dunbar, East Lothian (NT644792), V.C.82, 4/4/94 & 10/10/96, MS. Several sifted from moss in pine plantation in the company of the more common O. ovatus (L.).

Notaris aethiops (Fabr.). House of Water (NS557126), V.C.75, 1996, MDE.

Grypus equiseti (Fabr.). House of Water (NS557126), V.C.75, 1996, MDE; Fochabers (NJ336583), V.C.94, 1996, MDE; Pefferside Park, Dingwall, swept from horsetails (NH5459), V.C.106, 25/7/96, SM.

Pelenomus zumpti (Wagner), formerly in genus *Phytobius*. House of Water (NS557126), V.C.75, 1996, MDE. This species has been added to the British list (Morris, 1991) since Kloet & Hincks (1977) and has been recorded a few times in Scotland (Owen, 1991) in suitable habitat which includes saltmarsh with a population of its foodplant, sea milkwort *Glaux maritima* L. (Hodge & Jones, 1995).

SCOLYTIDAE

Xyloterus domesticum (L.). Millers Wood, Lanarkshire (NS820284), V.C,77, 9/6/96/ EGH. The normal host trees are beech or oak but these were emerging from holes in birch.

HYMENOPTERA

DIPRIONIDAE

Monoctenus juniperi (L.). Daviot Wood, larvae beaten from Juniper (NH7040), V.C.96, 7/8/96, SM; Welltown of Leys, larvae beaten from Juniper (NH6941), V.C.96, 7/8/96, SM.

CYNIPIDAE

Diplolepis spinosissimae (Giraud). Kingsteps, galls on *Rosa pimpinellifolia* (NH9860), V.C.96, 10/7/96, SM.

TORYMIDAE

Torymus nitens (Walker). Newhouse, Dounby, Orkney (HY290203), V.C.111, 24/6/96, JH.

FORMICIDAE

Formica lugubris Zetterstedt. Glen Affric, Inverness (NH2021), V.C.96, 18/5/96, EGH.

VESPIDAE

Vespula austriaca (Panzer). Culbin Forest, forestry plantation (NH9860), V.C.95, 13/7/96, SM.

ANDRENIDAE

Andrena coitana (Kirby, W.). Gyran Rabbit Warren, South Scatter, Yescanaby, Orkney (HY241155), V.C.111, 24/7/96, JH. Identified at the Natural History Museum, London and a new record for Orkney, previously known as far north as Golspie, Sutherland.

DIPTERA

TIPULIDAE

Tipula cheethami Edwards. River Tweed, Kelso Anna, pan trap (NT7234), V.C.80, 1996, MDE.

T. gimmerthali Lackschewitz. Ben Lawers, Perthshire, common over 3,000ft. (NN6441), V.C.88, 14/9/96, EGH.

Limonia distendens (Lundstroem). River Tweed, Kelso Anna, pan trap (NT7234), V.C.80, 1996, MDE.

Helius pallirostris Edwards. River Nith, north of Littlemark Hill, pitfall trap (NS8107), V.C. 72, 1996, MDE.

STRATIOMYIDAE

Microchrysa polita (L.). Newhouse, Dounby, Orkney (HY290203), V.C.111, 5/7/96, JH.

ASILIDAE

Rhadiurgus variabilis (Zetterstedt). Achnagall, near Moy, on bare ground in amongst heather (NH7536), V.C.96, 5/8/96, SM.

THEREVIDAE

Thereva handlirschi (Kröber). River Nith, Auldgirth, pitfall trap (NX9183), V.C.72; River Nith, south of Glenhall, pan trap (NX6813), V.C.72; River Spey, Aviemore, pan trap (NH8911), V.C.96, all 1996, MDE.

T. lunulata Zetterstedt. River Carron, Achnashellach, pitfall trap (NH0148), V.C. 105; River Nith, Kirkbog, pitfall trap and swept(NX8693), V.C.72; River Tweed, Altarstone, pitfall trap (NT1535), V.C.78, all 1996, MDE.

EMPIDIDAE

Tachydromia woodi (Collin). River Carron, east of Loch Sgamhain, pitfall trap (NH1153), V.C. 105; House of Water, Ayrshire, pitfall trap (NS557126), V.C.75; River Nith, Kirkbog (NX8693), V.C.72; River Spey, Tulchan Lodge, pitfall trap (NJ1335), V.C.95; River Spey, near Fochabers pitfall trap and swept (NJ3358) V.C.95; River Tweed, Altarstone, pitfall trap (NT1535), V.C.78; River Tweed, Horsburgh Ford (NT3039), V.C.78, all 1996, MDE.

Rhamphomyia trigemina Oldenberg. River Spey, Aviemore (NH8911), V.C.96, 1996, MDE.

Platyptera borealis (L.). Glen Affric, Inverness (NH2021), 18/5/96, V.C.96, EGH.

Hilara fuscipes (Fabr.). River Nith, Auldgirth, pan trap (NX9183), V.C.72, 1996, MDE; Tweed and Ettrick Water confluence, pitfall trap (NT4932), V.C.79, 1996, MDE; River Tweed, Mertoun (NT6231), V.C.80, 1996, MDE.

DOLICHOPODIDAE

Syntormon zelleri (Loew). River Carron, east of Loch Sgamhain, pan trap (NH1153), V.C. 105, 1996, MDE.

SYRPHIDAE

Melanogaster hirtella (Loew). Newhouse, Dounby, Orkney (HY290203), V.C.111, 1/7/96, JH. This species was formerly in *Chrysogaster* but has recently been placed in a different genus (Maibach, et al. 1995).

Syritta pipiens (L.). Newhouse, Dounby, Orkney (HY290203), V.C.111, 1/7/96, JH.

Eristalinus sepulchralis (L.). Bothwell Woods, Lanarkshire (NS689585), V.C.77, 8/6/96, GER.

OESTRIDAE

Hypoderma diana Brauer. Stairsneach nan Gaidheal, several flying along forestry track (NH736343), V.C.96, 16/6/96, SM.

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THE WATER BEETLES OF BADANLOCH BOG, SUTHERLAND

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INTRODUCTION

The Flow Country of Caithness and Sutherland in northern Scotland is one of the largest intact areas of peatland in the world. Much of it is at low altitude and of international significance for nature conservation (Lindsay 1995). During 1994 and 1995, several large areas of blanket peat bog in Sutherland were sampled extensively to provide information on invertebrate distribution in relation to breeding wading birds in the Flow Country. This paper concentrates on the aquatic Coleoptera taken from a typical Flow Country bog area where studies of wading bird distribution, behaviour and diet were concurrent.

Much recent work has been carried out on the aquatic invertebrates from peatland areas in both Caithness and Sutherland (Spirit 1986, Foster 1988, Spirit and Ryrie 1991), and also from peatland habitats in the western Highlands and Mull (Foster *et al.* 1991). These studies surveyed wide geographical areas, sampling large estates or even vice-counties, and included other habitats as well as bog areas. The broad sampling areas covered resulted in a relatively low sampling effort or short time spent at each site. Even so, an extensive species list for the freshwater habitats in the north of Scotland has accumulated, including almost 100 species of aquatic Coleoptera. This study examined the species found within one pool system, and investigated the broad differences between the main bog pool types in more detail.

All samples in this study were taken from Badanloch Bog, a large blanket bog system in East Sutherland (V.C. 107; National Grid Reference NC 793329, 5.07km^2 area). Figure 1 shows the approximate location of the bog. In typical relatively undisturbed bog habitats, such as that found at Badanloch, there are several distinct types of pools, dependent on the overall size, drainage and catchment area of the bog. (Lindsay 1995; and Lindsay *et al.* 1988) describes the different pool types in detail. The present study concentrated on the two principal pool types found on Badanloch Bog; deep semi-permanent pools (Dubh Lochans, hereafter referred to as D-pools), typically found at the highest point of the bog surface, and shallow drought-sensitive pools (A-pools), most commonly found surrounding the Dubh Lochans. The vegetation surrounding both pool types was National Vegetation Classification type M18 (*Erica-Sphagnum* mire).

METHODS

Two principal trapping methods were used in order to sample invertebrates from both within the pools and from the surrounding vegetation. Water traps were developed to sample the abundance, species composition and possible emergence times of the aquatic invertebrates present in the main pool system, a habitat often selected by wading birds for feeding (Nethersole-Thompson and Nethersole-Thompson 1979). The water traps used were of a funnel and bottle design with a

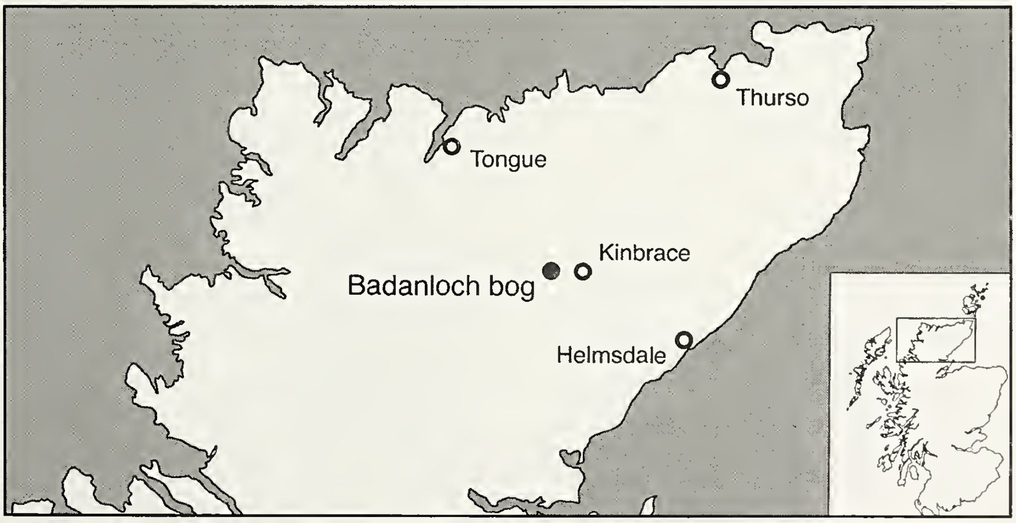

Figure 1. Approximate location of Badanloch Bog, Sutherland.

22mm circular entrance aperture, allowing easy access but limited or no escape once the invertebrates were trapped. The traps were orientated either vertically or horizontally within the water. Only vertical traps could be used in the A-pools owing to the relatively low water levels, and these traps were positioned with the funnel downwards. During 1994, 36 traps were operated simultaneously in different pools: 12 vertical in A-pools, 12 vertical and 12 horizontal in D-pools. During 1995 the number of traps was reduced to 24: six vertical in the A-pools, 18 horizontal in the D-pools (again, all in separate pools). These 18 horizontal D-pool traps were further split into six traps at the edges and six near the centre of the pools, and six traps at the edges with wire across the mouth of the trap to prevent the larger Dytiscidae species from entering. Any variation between the different traps placed within the D-pools will be described in more detail at a later date; only the presence of species in either pool type is described here. Traps were operated for three days after each of the dates shown in Table 1. All traps were tethered to a cane to prevent movement within the pool.

Table 1. Sampling dates for different trapping methods during 1994 and 1995. Water trap dates indicate start of a three day sampling period. Pitfall traps operated continuously, collections every 14-15 days.

	1994	1995
Water traps	14 May, 2 June, 17 June, 1 July, 13 July, 29 July and 24 October	18 April, 4 May, 18 May, 3 June, 19 June, 1 July and 15 July
Pitfall traps	4 April to 22 October	1 April to 29 October

Table 2. Aquatic Coleoptera taken in water traps and pitfall traps from Badanloch Bog during 1994 and 1995. A represents A-pools (shallow drought sensitive); D represents D-pools (large Dubh Lochans).

		Water traps		Pitfall traps	
		A	D	A	D
	DYTISCIDAE				
1	*Hydroporus erythrocephalus* (L.)	+	+		
2	*Hydroporus gyllenhalii* Schiödte	+			
3	*Hydroporus melanarius* Sturm			+	+
4	*Hydroporus obscurus* Sturm	+	+		
5	*Hydroporus pubescens* (Gyllenhal)	+			
6	*Hydroporus tristis* (Paykull)			+	
7	*Stictotarsus multilineatus* (Falkenström)		+		
8	*Platambus maculatus* (L.)			+	+
9	*Agabus arcticus* (Paykull)	+	+	+	+
10	*Agabus bipustulatus* (L.)	+	+	+	+
11	*Agabus congener* (Thunberg)	+	+	+	+
12	*Agabus montanus* (Stephens)	+			
13	*Ilybius aenescens* Thomson	+	+		
14	*Rhantus suturellus* (Harris)	+	+	+	
15	*Acilius sulcatus* (L.)		+		
16	*Dytiscus lapponicus* Gyllenhal		+		+
17	*Dytiscus marginalis* L.		+		
18	*Dytiscus semisulcatus* Müller		+		
	HYDROPHILIDAE				
19	*Megasternum obscurum* (Marsham)				+
20	*Anacaena globulus* (Paykull)			+	+
21	*Enochrus affinis* (Thunberg)	+		+	
22	*Enochrus fuscipennis* (Thomson)	+			
	CHRYSOMELIDAE				
23	*Plateumaris discolor* (Panzer)		+	+	
	Total number of species	12	13	10	8

Pitfall traps were used to sample the invertebrates from the surrounding pool vegetation (all traps approximately 1m from the water edge). Five traps (45mm mouth diameter, 2% formalin/detergent solution) were placed 2m apart in a straight line, set flush with the surface within the areas dominated by each pool type. The pitfall traps were in place continuously from early-April to late-October during both years (Table 1), and were emptied every 14-15 days.

RESULTS AND DISCUSSION

A total of 23 species of adult aquatic Coleoptera was found from both years combined, the majority belonging to the Dytiscidae, as shown in Table 2. Larvae were not identified. The total number of species taken from the A-pools was the same as the number found in the D-pools, i.e. 17, after combining both water and pitfall traps. Eleven species were taken only from water traps, and five were taken only from pitfall traps, suggesting a high degree of species separation between the water and the adjacent vegetation, as was expected. Six species were taken only from the A-pools and the surrounding area, and similarly six species were found only from the D-pool habitat.

Beetle size is probably one of the most important factors limiting species distribution between the two pool types, larger species requiring more space in which to swim (Ribera and Nilsson 1995), and in general these larger species were more common in the larger D-pools. The 23 species range from 1.5 mm to 35 mm in length (Joy 1932, Nilsson and Holmen 1995), though only six had a mean of >10 mm (*Agabus bipustulatus, Rhantus suturellus, Acilius sulcatus* and three *Dytiscus* species). Of these six, the last four (and also the largest four taken) were restricted to the D-pools. The first two were found in both pools types. In general, the smaller species taken were found in either or both pool types, suggesting they could utilise both habitat types to a greater degree than the larger species.

Figure 2 shows the seasonal distribution of adults of eight of the more commonly found species, expressed as a percentage of the total yearly catch for that species, from water traps only (A- and D-pools combined). Most of the species showed a peak in abundance or activity in May/June of both years. However *Agabus bipustulatus* shows a later peak in the 1994 catch (during July and still high in October) compared with the earlier peak in 1995 (during May). This may be due to variation in the seasonal temperature between years. Only one species showed a consistent peak in adult abundance later in the season compared with the majority of the other species; *Ilybius aenescens* had peaks in abundance in late June and July. Only *A. bipustulatus* and *Dytiscus marginalis* appeared to remain active during October (more than 10% of the 1994 catch taken during October sampling period), although a few specimens of *A. arcticus* and *D. lapponicus* were taken. The seasonal patterns of the species described above were broadly similar to their seasonal catches in the pitfall traps.

Although only 23 species of aquatic or semi-aquatic Coleoptera were found during this survey compared with nearly 100 species known for the Flow Country area, it nevertheless indicates a more diverse habitat than was previously thought. The intensive and long-term sampling of a relatively small area, coupled with variation in sampling methods have proven beneficial in gaining a fuller picture of the species present. One drawback of collecting species lists from water traps such as used in this study is the bias for species from within the water body, with species which are more active on the water surface (e.g. Gyrinidae) being under-represented. Nevertheless, the methods used here have proven to be an effective and relatively low-mainenance way of sampling the aquatic fauna.

Most of the species collected are considered typical for these types of habitat, and the list did not include any species which had not been found in similar habitats by other workers elesewhere in the north of Scotland. *Dytiscus lapponicus*, *Megasternum obscurum* and *Plateumaris discolor* are considered new records for East Sutherland, though this may be a reflection of the large area and volume of inland freshwater coupled with the small number of studies, rather than an influx of new species to the area. Four species are considered Nationally Notable B in their status according to Hyman and Parsons (1992, 1994); *Stictotarsus multilineatus*, *Ilybius aenescens*, *Dytiscus lapponicus* and *Enochrus affinis*. During 1995, horizontal water traps were also placed at the edge of nearby Loch Achnamoine (NGR NC 810324) which bordered

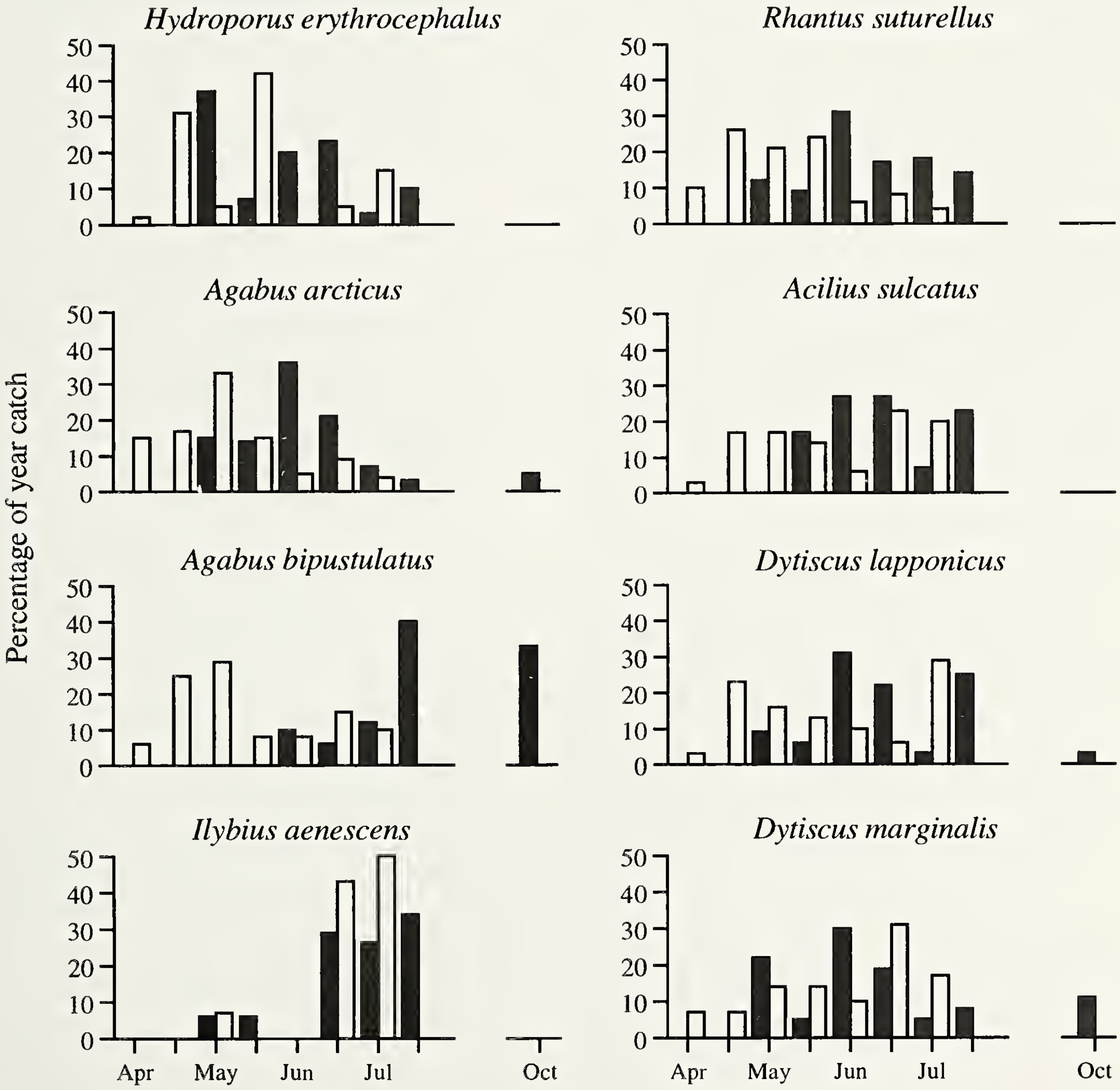

Figure 2. Seasonal distribution of the more commonly trapped species (>40 specimens (in water traps only) over two years) expressed as a percentage of the total year catch of that species. Dark bars are 1994 catch, white bars are 1995 catch.

the bog. However, they were subject to damage from windfetch and otters, and were discontinued (only one trap worked during the first period). Only one species of water beetle was collected during this period, *Oreodytes alpinus* (Paykull). This species has only recently been found in Britain (Foster and Spirit 1986). It is more common in northern Fennoscandia and probably Siberia (Foster 1986), and is classed as RDB3 (Hyman and Parsons 1992, 1994). The western sandy edge of the loch from which the species was taken was typical of other localities where it has been found previously (Foster 1986). It seems likely therefore that the water beetle fauna of the bog area is very similar to that of other Holarctic areas, and is of interest due to its possible arctic-alpine characteristics (Lindsay *et al.* 1988).

The pool systems and surrounding vegetation provide a potential food source for breeding birds such as greenshank, dunlin and golden plover, and as such are important conservation features. The wader breeding distribution coincides generally with increases and seasonal peaks in abundance of the water beetles in and around the pools, and evidence from dietary studies indicates that aquatic Coleoptera make up an important part of the waders' diet, especially that of greenshank (Downie *et al.* 1996). The D-pools are the most important and predictable food reservoir during the breeding season as they are the least influenced by drought, the A-pools being more susceptible to dry summer conditions (Lindsay *et al.* 1988). This might in part explain why most of the British greenshank population (c. 66%) resides in the Caithness-Sutherland region, as the bog surface pool-structure further south or in the extreme west is made up of smaller pools which are subsequently more drought sensitive (Lindsay *et al.* 1988). Ironically, the structure of the D-pools usually makes wading difficult for birds as they are usually deep, sharp-sided lochans. However, summer weather often reduces the water level, making wading possible. In wetter years, the birds would presumably use the shallower A-pools, or wade around the sides of larger lochs or river shallows to obtain the aquatic component of their diet.

ACKNOWLEDGEMENTS

We would like to express our thanks to the owners of Badanloch Estate and their staff who kindly provided access to the study site. We are grateful to G. Liddle, M. O'Connell, S. Twiss and J.M. Yelloly for assistance with sampling during both years. The work was carried out during a contract to Durham University from Scottish Natural Heritage (RASD 94/95 - 002). SAC receives financial support from the Scottish Office Agricultural, Environment and Fisheries Department.

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A PALMATE NEWT POPULATION IN ACID BOG POOLS IN THE SUTHERLAND FLOWS OF NORTH SCOTLAND

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INTRODUCTION

The Flows of Sutherland have been intensively planted with conifers for commercial timber production since 1981. The palmate newt (*Triturus helveticus* (Razoumowsky, 1789)) was known to be widespread in the pool complexes which characterise the Flows and there was concern that the acidification of the water and lowering of the water table resulting from afforestation, might adversely affect *T. helveticus* populations. The following is an account of a study which compares newt populations at four pool complexes in Helmsdale. The sites lie within a major area of peat formation characterised by mild winters, cool, cloudy summers with relatively low rainfall (approximately 1,000 mm), but many rain days resulting in surplus of 200 mm precipitation and an average daily mean temperature of 8°C (Ratcliffe and Oswald, 1988).

METHODS

Two systematic surveys were made, the first in May (20th-23rd) and the second in June (25th-28th), 1994. Two transects were established across each of four pool complexes - two at Loch nan Clar (**LNC**, NC776378; NC780379) which were still open, and two at Woodcock Hill (**WH**, NC900474; NC893468) which had been enclosed by Sitka spruce (*Picea sitchensis* ((Bong.) Carr.)) plantations four and seven years previously (Fig. 1). Planting was to within 20 m of the edge of the outermost pools and none were overhung by trees. Each pool crossed by a transect was classified using the typology described by Lindsay (1995) and the pH, depth of clear water and perimeter were recorded. Pools were searched for one minute for each 2 m of pool perimeter and all newts seen were netted. Night searches were not possible as it was too hazardous to work on the bog surface without daylight. Small numbers of common frog larvae were found but *T. helviticus* was the only newt species present. The snout - vent length of each newt was measured, adults were sexed and each was returned to its pool. In total, 188 pools were sampled and 11 first year larvae, 184 second year larvae, 19 males and 11 females were caught. Samples of vegetation were searched during both surveys but only one egg was found in June.

RESULTS AND DISCUSSION

Pool variables

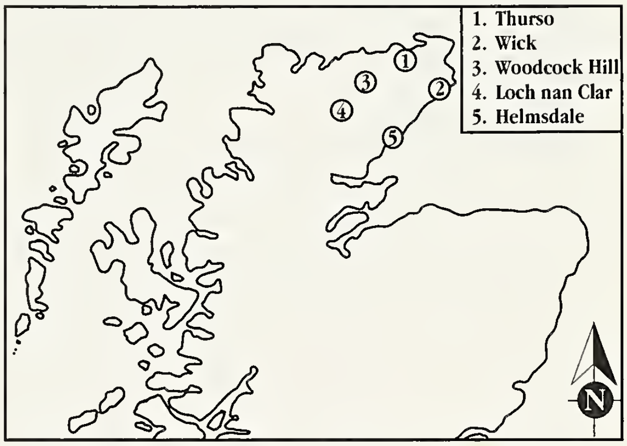

Figure 1. Map of Northern Scotland showing sampling locations at Woodcock Hill (3) and Loch nan Clar.

The pool types differed with respect to several variables (Table 1) and therefore they were treated separately in assessing the effects of afforestation on newts. A1 pools (sphagnum pools) are small and shallow (average 13 cm in this study) with a soft peaty substrate and lined with *Sphagnum cuspidatum* Hoffm.. A2 pools (peat hollows) are small and shallow (average 7 cm) but develop over a solid, thin layer of peat while A4 pools (Dub lochans) are deep (average 28 cm) and steep sided with a soft peaty substrate and sparse *Menyanthes trifoliata* L. (bog bean). A4 pools are very irregular in shape so that the perimeter may be large - up to 100 m - whereas the maximum width measured was only 5 m. Despite the generally high water table throughout the Flows, some of the shallow pools dry out in most years.

The pH of the A1 pools was lowest and A4 pools highest with A2 pools intermediate, and the differences were significant at both sites (ANOVA: LNC: F2,87=10.45, P<0.001; WH : F2,99=38.1, P<0.01). Bog pools are naturally acid because *Sphagnum* and peat both have a high affinity for cations and, in binding them to their surface, release H+ ions into the water (Clymo, 1967). This phenomenon may explain the lower pH of the shallow, *Sphagnum*-lined A1 pools compared with the A4 pools, which are bigger and deeper, with a large volume of water and no *Sphagnum*. The A2 pools are shallow, but they have no *Sphagnum* and their peat is thin and contains mineral particles.

Forestry could affect mire pools in several ways. When afforestation takes place, the land is first ploughed and this may release transition elements from soil which affect the pH of water courses (Good, 1987). Where a peat bog is ploughed, the pH of the already naturally acid pools containing peat and *Sphagnum* may be reduced further. The pH of both A1 and A4 pool types was significantly lower at the forested sites than at the open sites (A1: F1,94=50.8, P<0.001; A4: F1,52=6.3, P<.01), while the pH of the mineral-affected A2 pools was not significantly different. Forestry plantation may lower the water table of surrounding habitats (Ratcliffe and Oswald, 1988).

However, Pyatt *et al.* (1992) established that at 20 years of age, the plantation trees had "taken over" the drainage of the ground in which they were planted (a wet blanket bog in Caithness, N. Scotland) and caused irreversible reduction in the peat water content, but "In a zone up to 20 m outside the trees... the water table remained close to the surface right up to the edge of the forest canopy". In this study there was no significant difference in the depth of any of the three pool types between open and forested sites, indicating that, at least during the early growth of the conifer crop, the water table of the neighbouring area had not been lowered.

The newt population

i. Life history

During a preliminary survey in April only large newt larvae with fore and hind limbs were seen. All the larvae caught in May, and all but 11 individuals in June, had limbs and were considered to have been laid as eggs in the previous year and overwintered. The 11 limbless larvae were too small to measure accurately in the field and were not considered further. The size and number of individuals caught is shown in Fig. 2 and Table 2. The average size of larvae (mean +1 S.E.) in May was 16.4 mm + 0.23 (n=118, range = 10-23 mm) and in June it was 18.0 mm + 0.21 (n=66, 14-22 mm) giving an average apparent larval growth rate in the field of 1.6 mm in 35 days. 19 males (range 34-40 mm) and 11 females (range 36-48 mm) were caught, but no metamorphs were found in the pools.

In addition a number of animals were caught accidentally in pitfall traps set in the bog surface from May to October to catch invertebrates. 74 metamorphs were caught between June (n=3) and October (n=8) with a peak in August (n=41). The average size of metamorphs was 21.1 mm + 0.19. Only 9 adult males (range 32-42 mm) and 9 females (range 36-44 mm) were caught in the land traps between July and October.

The number of individuals caught is shown in Fig. 3. In this population of *T. helveticus* it appears that eggs are laid and hatch starting in June, all larvae remain in pools over winter, larvae then metamorphose and leave their natal pools approximately 12 months after hatching. Adults were found in pools but not in traps in May and June, suggesting that they were already in the pools but apparently not breeding until June. They start to leave pools in July and either overwinter on land and move into the pools in early spring, or, when they leave the breeding pools in July onwards, they disperse to new pools where they overwinter.

No animals between the size of the largest metamorph (27 mm) and the smallest adult (32 mm) male were found by either method (Fig. 2). There could be several explanations for the absence of these post-metamorphic juveniles - 1) they are terrestrial, but, as sit-and-wait predators, would not be expected to fall into traps; 2) the year prior to sampling was disastrous for newt recruitment and there were simply insufficient numbers to detect; 3) they disperse to habitats not sampled; 4) the metamorphs leave pools starting in June to disperse to other ponds where they overwinter, feeding on the abundant overwintering invertebrates, and continue to grow and mature by May the following year. Further work is required to establish the life history of adults, sub-adults and metamorphs in this area.

Table 1

The characteristics of pools of different types at open sites at Loch nan Clar (LNC) and the forested sites at Woodcock Hill (WH).

Pool type	Site	N	Perimeter sampled	Av. pH	Av. depth
A 1	LNC (open)	16	261	4.18	12.3
	WH (forested)	78	1988	4.09	12.6
A 2	LNC (open)	36	471	4.19	6.8
	WH (forested)	6	72	4.13	5.8
A 4	LNC (open)	37	1237	4.26	27.2
	WH (forested)	15	1827	4.2	26.4

Table 2

The number and size of *Triturus helveticus* life history stages. Pools were sampled in May and June where all larvae and some adults were caught. Pitfall traps were set for invertebrates from May to October and metamorphs were accidentally caught from June to October while adults were caught from July to October.

N= number of individuals; SVL= snout-vent length (mm).

	Larvae	Metamorphs	Males	Females	All adults
May					
N	118		13	9	
SVL (average mm)	16.4		36.2	41.0	
SVL (range mm)	10 23		34 - 39	36 - 48	
June					
N	66	3	6	2	
SVL (average mm)	18.0	20.0	36.6	41.0	
SVL (range mm)	14 - 22	18 - 22	34 - 40	40 - 42	
July					
N		10	1		
SVL (average mm)		20.3	37		
SVL (range mm)		18 - 22			
August					
N		41	2	2	
SVL (average mm)		21.1	36	40.5	
SVL (range mm)		18 - 24	36 - 36	38 - 43	
September					
N		15	4	3	
SVL (average mm)		22.0	35.2	40.0	
SVL (range mm)		18 - 27	32 - 40	36 - 42	
October					
N		8	2	4	
SVL (average mm)		22.0	39.0	42.0	
SVL (range mm)		19 - 24	36 - 42	40 - 44	
Combined					
N		74	27	20	47
SVL (average mm)		21.1	36.3	40.5	38.3
Standard deviation		1.67	2.46	3.32	3.54
SVL (range mm)		18 - 27	32 - 42	36 - 48	32 - 48

Table 3

The average number per 10m edge sampled of *T.helveticus* adults and larvae in pools of different types at open sites at Loch nan Clar (LNC) and forested sites at Woodcock Hill (WH).

Site	Adults		Larvae	
	N	av./10m	N	av./10m
A1 LNC (open)	0	0	7	0.27
WH (forested)	5	0.025	71	0.36
A2 LNC (open)	0	0	0	0
WH (forested)	0	0	0	0
A4 LNC (open)	18	0.15	81	0.65
WH (forested)	6	0.033	25	0.14

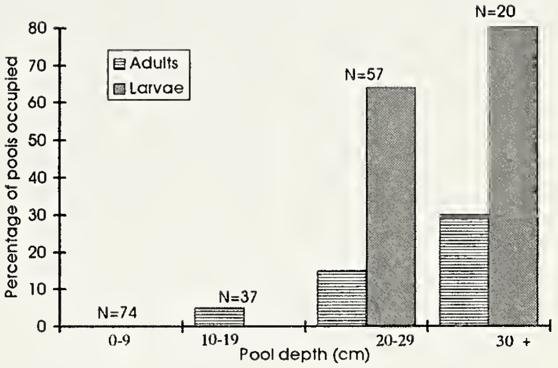

Figure 5. The percentage of pools of different depth occupied by adult and larval *T. helveticus*. (N=number of pools sampled)

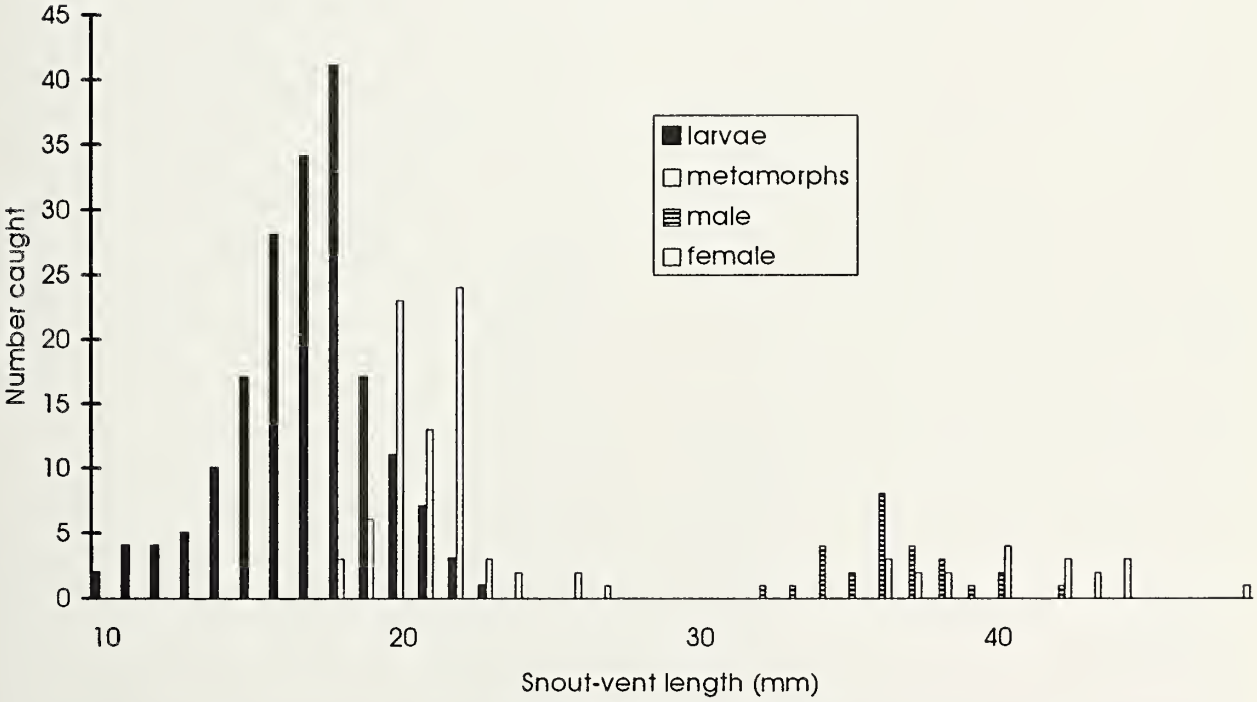

Figure 2. The number of *T. helveticus* of each size class caught by netting and in pitfall traps, May - October 1994.

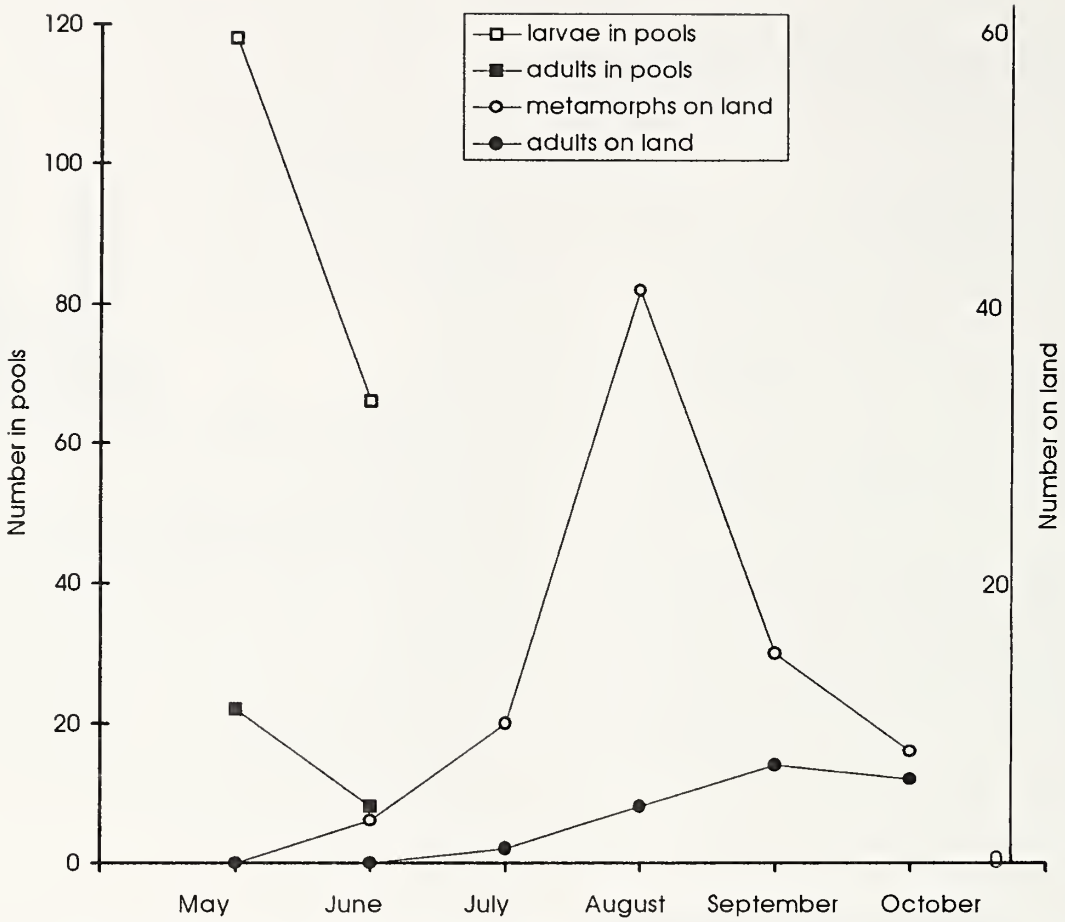

Figure 3. The total number of *T. helveticus* of each life history class caught each month in 1994. Note that the scale for animals caught in pools and on land differs.

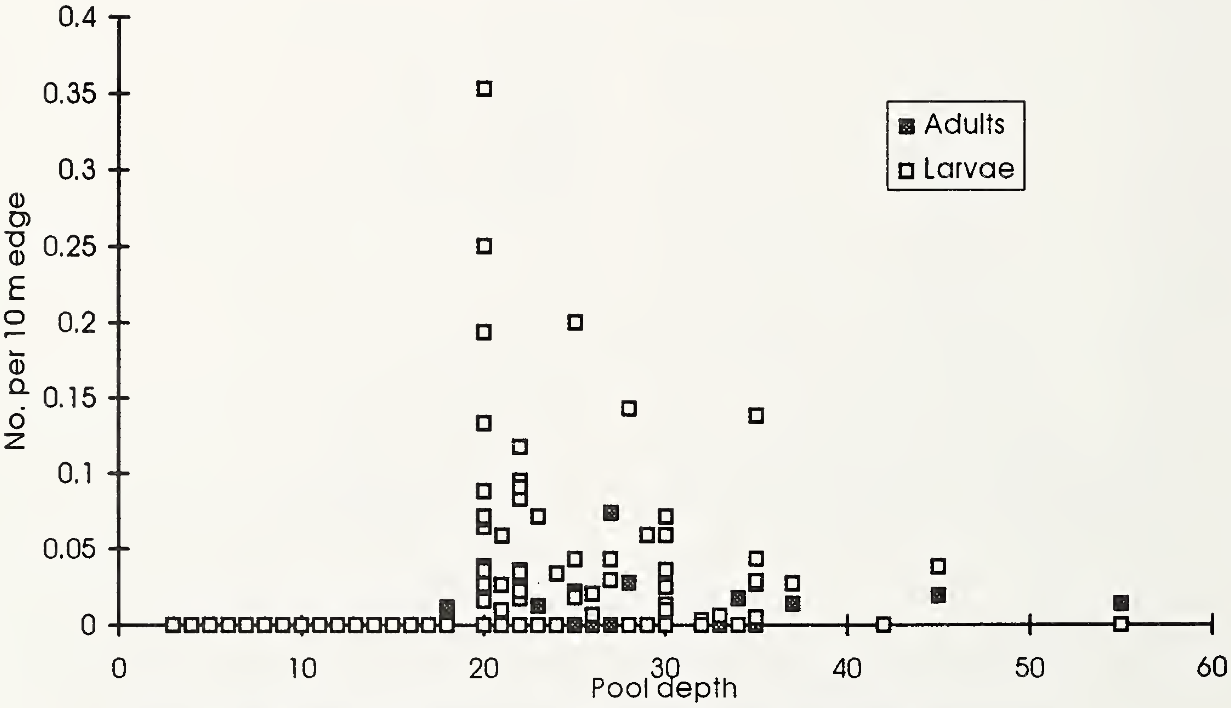

Figure 4. The abundance of adult and larval *T. helveticus* in a pool irelation to pool depth (cm).

ii. Larval abundance and pool variables

The average number of larvae per 10 m pool edge sampled is shown for different pool types in Table 3 which shows larvae were most abundant in the A4 pools at the open complexes.

The influence of pool variables and forestry on newts was investigated on a presence or absence basis, using Chi-square test. Taking pools of different types separately, there was no significant difference in the number of pools with or without newts, between open and forested complexes. This would indicate that the lowered pH of A1 and A4 pools detected in the forested sites has not affected the newt population. This was reinforced when the number of larvae per 10 m pool perimeter sampled was plotted against pool pH, no relationship was found although no larvae were found in the very few pools below pH 4.04. No newts were caught in the A2 pools which had relatively high pH, but which were all shallow (see below). When comparing development and growth of *T. helveticus* at neutral and sub-lethal acid conditions, Griffiths *et al.* (1993) found survival to hatching and growth rate was reduced at pH 4.45. It cannot be confirmed that low pool pH impacted on larval development, but if it did so, it appeared to be operating uniformly throughout the pH range encountered.

The number of larvae found in pools of different depth is shown in Fig. 4. Of all pools sampled, 111 were below 20 cm depth (this included all the A2 pools), none contained larvae and only two contained adults, while of the 77 pools over 20 cm deep, 75% contained one or more larvae and 25% one or more adults (Fig. 5). This important impact of pool depth on newt occurrence may be due to-

1) summer drought which dries out shallow pools and traps and kills first year larvae which have failed to develop in time to leave the pools earlier (because of late breeding, low water temperature and low pH); 2) shallow pools freezing throughout their depth during winter which kills the overwintering larvae. Some of the pools are temporary most years and larvae developing from eggs deposited there in May or June would die in late summer. The impact of freezing is unknown.

However, it was established at these sites that forestry has had no effect on pool depth, and it would appear that whichever factor causes larval death in shallow pools, it is a natural phenomenon due, in part, to the instability of some pools.

CONCLUSION

The Palmate newt is found more commonly in water bodies with low pH (Cook and Frazer, 1976), but has a more restricted European distribution than the two other British species - *T. cristatus* (Laurenti) and *T. vulgaris* (L.), being confined to western Europe, absent from most of Scandinavia and at its northern limit in Scotland (Arnold and Burton, 1978). The species is found throughout Britain, although apparently sparsely distributed in the east midland counties (Arnold, 1995). It was the only newt species present in the Flow pool complexes studied and was present in a substantial number of pools examined. Low densities were encountered - partly because breeding is late and larvae suffer high mortality due to desiccation of shallow pools in late summer - and partly due to reduced survival at low pH. All larvae were thought to overwinter. There is the possibility in this mire habitat, where there is a total lack of cover other than vegetation and winters are mild, that metamorphs, sub-adults and adults do not hibernate on land, but overwinter in pools where they may continue to feed and develop more quickly than might be predicted from the low average annual temperature of the region.

The Palmate newt population of the complexes was most affected by pool depth which consequently affects their distribution between pools of different type. Larvae were not found in any A2 pools, in only 18% of A1 pools, but in 69% of the deep A4 pools, taking both sites together. The larval population has not been affected by forestry via changes in the water table so far, i.e. 6 years after afforestation.

Conversely, while forestry appears to have lowered the pH of the types of pool where larvae were found (A1 and A4), larval numbers at the forested sites seem not to have been affected by acidification.

ACKNOWLEDGEMENTS

I.S. Downie and J.C. Coulson kindly made available newts accidently caught in traps during their survey of the invertebrates of the bog surface. We are grateful for the help given by the staff of Scottish Natural Heritage in arranging access to the sites, and to the landowners of the Loch nan Clar and Woodcock Hill estates for giving permission to sample the pool complexes.

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Plate 1

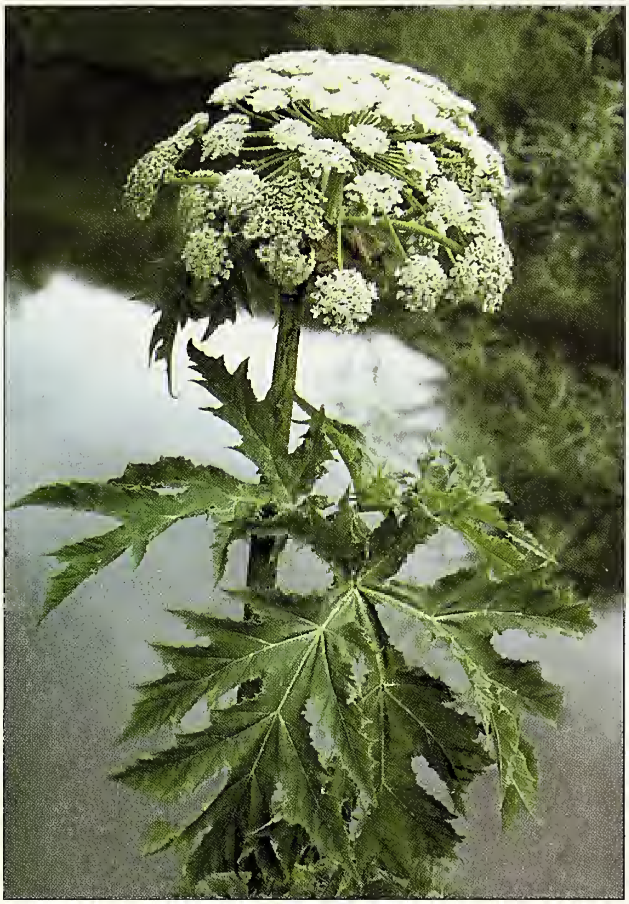
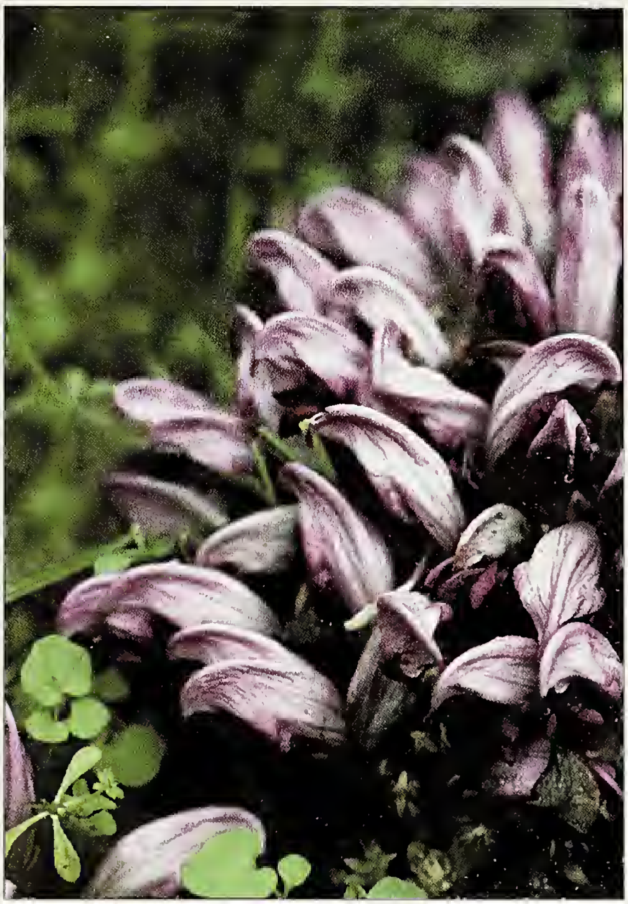


photo: P. Macpherson

Giant Hogweed
(Heracleum mantegazzianum)



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Purple Toothwort
(Lathraea clandestina)

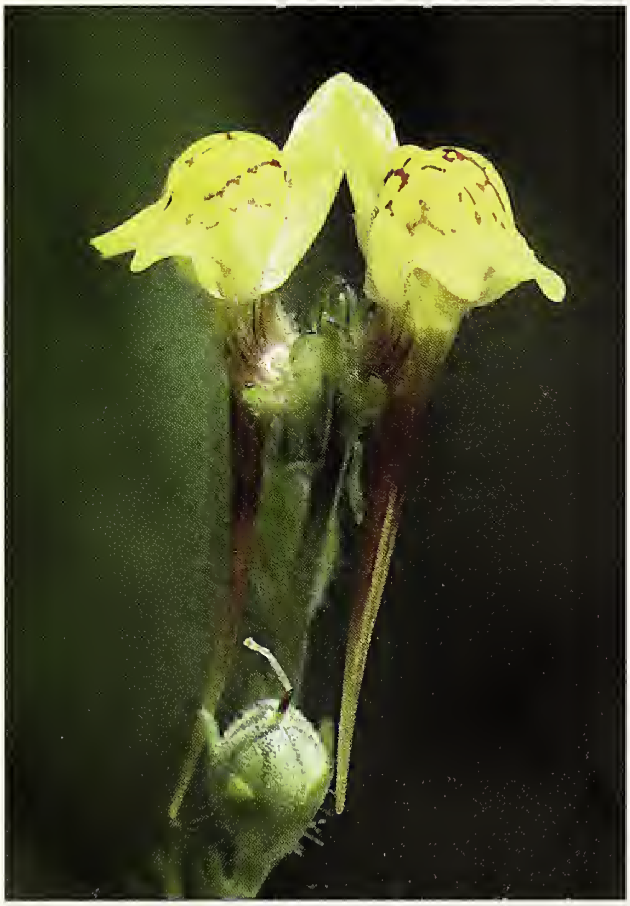


photo: T. Norman Tait

Multi-spotted Toadflax
(Linaria amethystea ssp.multipunctata)

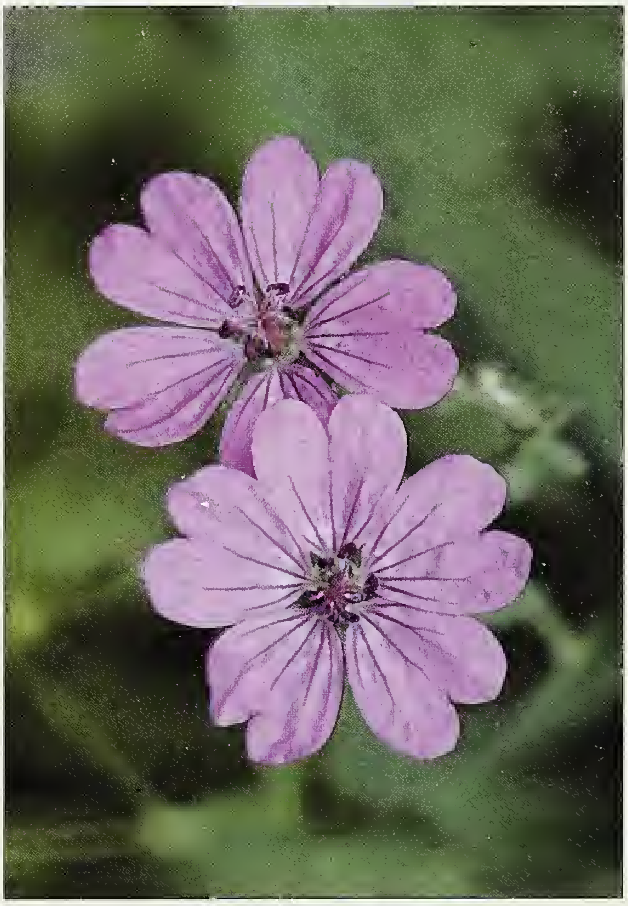
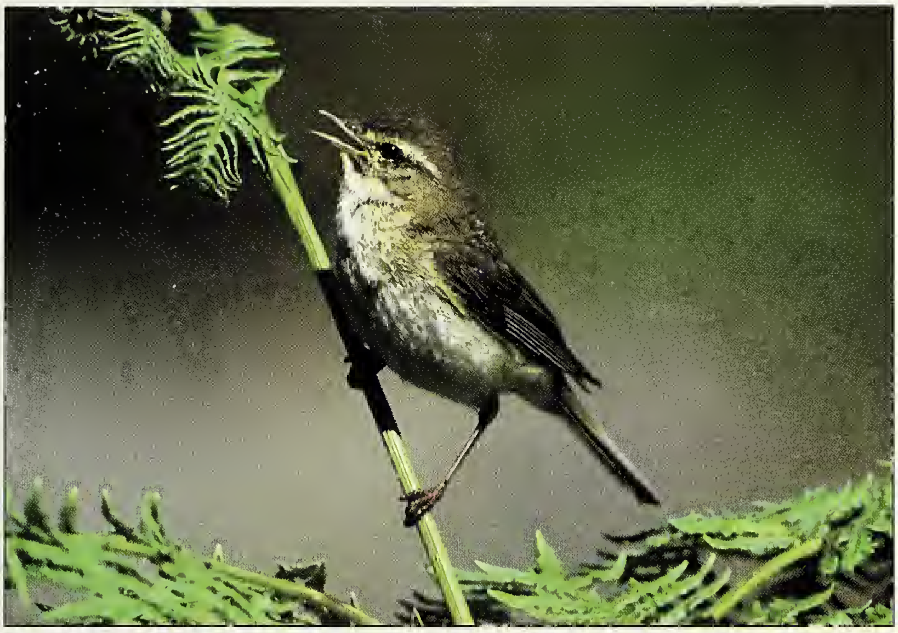


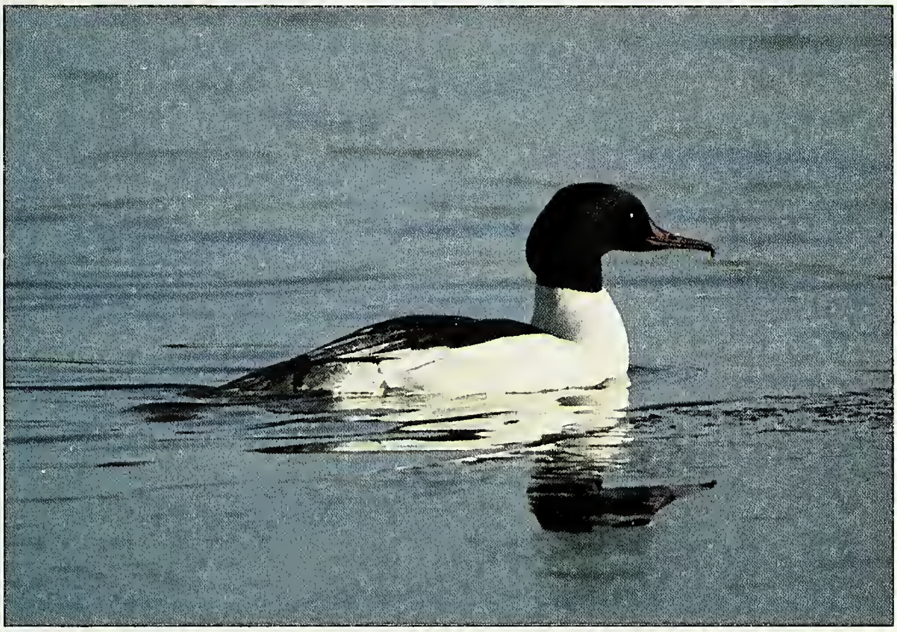
photo: T. Norman Tait

Hedgerow Crane's-bill
(Geranium pyrenaicum)



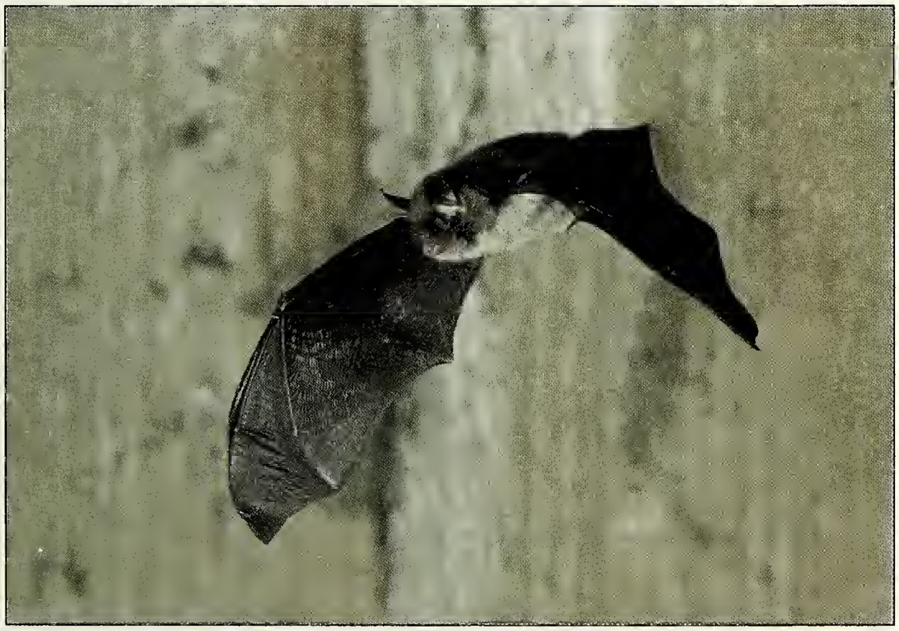
Willow Warbler
(Phylloscopus trochilis)

Visits the Gardens briefly in spring and autumn in passage to and from summer breeding territories.



Male Goosander
(Mergus merganser)

A winter visitor to the River Kelvin. Females and immatures have a chestnut-rufus head and a grey back.



Pipistrelle Bat
(Pipistrellus pipistrellus)

The bat is flying around an outhouse. Ultra sonic emmisions from the mouth help the bat to locate the exit from the building.

All photos: T. Norman Tait

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SUPPLEMENT

ON THE WILDSIDE

THE NATURAL HISTORY OF THE GLASGOW BOTANIC GARDENS

INTRODUCTION

During the period from 1994 to 1997 a number of members of the Glasgow Natural History Society have been visiting the Glasgow Botanic Gardens regularly in order to survey the wildlife to be found there. The results are diverse and provide information on a broad range of plants and animals.

The idea of conducting this survey grew from a suggestion that fieldwork in an accessible area would involve more members in an interesting exercise and promote the practical natural history activities of the Society. This latter aim was fulfilled most effectively through the involvement of the Friends of Glasgow Botanic Gardens and the staff of the Gardens themselves. As an example of the effect of this, extra publicity saw more than forty people turn up one evening to witness nocturnal urban wildlife. Moths were seen in the act of being trapped by an ultra-violet insect light and bats performed their aerial antics through the trees. To finish off the evening the resident Tawny Owl hooted a farewell.

A snapshot of the natural history of the gardens in the late twentieth century is of some relevance in the present climate of interest in urban wildlife and city regeneration. Some of the earlier generations of naturalists left behind information for comparison by which changes during the last century can be measured. The area which is now the Gardens, in the middle of the west end of Glasgow, was formerly arable farmland which became urbanised. Air pollution, before the creation of smokeless zones, and the almost complete loss of aquatic life from rivers were to have a profound effect on the environment. This was not unique to Glasgow but is found in all major industrial cities. Now that these trends have been reversed, by the introduction of various laws protecting the environment, the increase in urban wildlife diversity is something that can be observed by all. A repeat of this survey by the Society at a

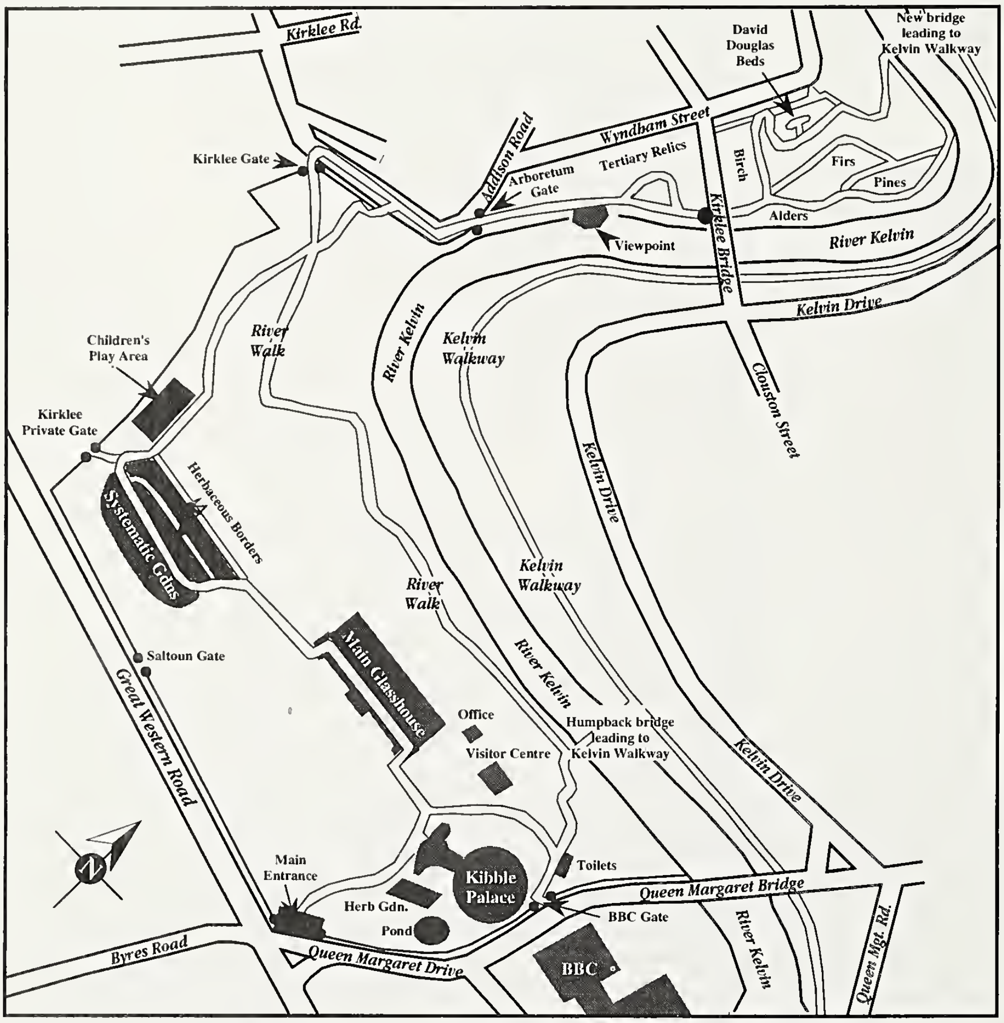

Figure 1. Map of Glasgow Botanic Gardens showing main paths only.

future date will reveal more changes, hopefully expressed in an even greater range of wild plants and animals coming to live within our city.

It is intended to collate the reports published here, with a number of others still in the process of being written, into a separate booklet for issue as a guide for visitors to the Gardens. The initial ones reproduced in this issue of the Glasgow Naturalist are listed below. The map (Fig. 1) will help those unfamiliar with the Gardens to get their bearings.

An historical introduction - Eric Curtis

Plants growing in a wild state - Peter Macpherson

Trees - Bob Gray

Birds for all seasons - Norman Grist and Ian McCallum

Resident wildlife seen and unseen: Mammals - Richard Sutcliffe

Underneath it all: the geology of the area - Brian Skillen

ACKNOWLEDGEMENTS

The Society is grateful for the support of the staff of the Glasgow Botanic Gardens, particularly Euan Donaldson and Paul Matthews. They have not only helped with information and various practical aspects but spent some of their own leisure time in allowing access out of normal hours.

Edited by **E.G. Hancock**

AN HISTORICAL INTRODUCTION

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On 11 November 1839 the Royal Botanic Institution of Glasgow bought the present site of the Botanic Gardens, while temporarily maintaining the original Garden founded in 1817 at Sandyford (a stone in the wall of a building near the Henry Wood Hall marks the site). The Royal Botanic Institution was run like a company with shareholders. The Directors were prominent academic and business figures in the City, and there was a formal link with the University.

The foundation was the result of the initiative of Thomas Hopkirk the Younger of Dalbeth. A distinguished amateur botanist, and author of the first flora of the Clyde area (Flora Glottiana), he donated his plant collection to form the nucleus of the new garden. His plants had been looked after by Stewart Murray who became the first Curator of the Garden. By good fortune (Sir) William Hooker was appointed Regius Professor of Botany shortly after the Garden was founded and during the next 20 years - until he became the first Director of the Royal Botanic Gardens, Kew - he gave strong support and used the Garden extensively. Many new plants came to Glasgow through his initiative and were described and illustrated by him.

Just as the original 18th century Physic Garden of the College in the High Street had succumbed to industrial pollution, so did the Garden on the Sandyford site. In 1836 Principal Macfarlan of the University, then Vice-President of the Royal Botanic Institution, explained that the rapid west-ward development of the City had led to a great increase in the financial value of the land while at the same time its value had deteriorated as 'an instrument of science'. The Annual Report of 1839 states that 'whereas when the Garden was founded it was practical to grow many varieties of the Pine Tribe [now] there is not a single healthy pine .. and the Heath, the Holly and many of the Alpine Plants are gradually sharing the same fate'. There had for some years been a search for a new site and early that year Stewart Murray recommended 'Mr Mowbray's ground of Horselethill', where co-incidentally the Observatory of the Glasgow Astronomical Society was also to be built.

The Botanic Institution and the Astronomical Society were the first organisations to move into what was to become Glasgow's West End. At this period speculative builders were looking for land for housing the expanding upper middle class and the planned Great Western Road authorised by an Act of Parliament in 1836, made this area practical. The farmland and open countryside, with its wooded drumlins along the River Kelvin, was ideal. Developers were able to point out that the prevailing west wind made it 'healthful and well-aired' in contrast to the unhealthy old town. One builder gave a typical description: 'The surface is varied, mostly elevated and commanding fine views and securing good air .. a landscape truly picturesque'. However, as it was also rich in coal, iron, free stone, sand and brick clay it could easily have become an industrial area. Already there were well established small industries using the water power of the River Kelvin. Builders were to be offered free use of what was found on site and the whole area became dotted with quarries and brick pits.

The major pioneers in these developments were Mathew Montgomery -who lived in Kelvinside House, on the north side of the Kelvin opposite the Gardens - and his partner John Park Fleming who purchased the Kelvinside Estate, including Horslethill farm, in 1839. They formed a remarkable legal partnership which lasted for over 50 years and was inherited by the flamboyant James B Fleming, their nephew and son respectively. Montgomery and Fleming aimed to make the suburb of Kelvinside the best residential district of the City, stating that 'the whole of these 450 acres are to be occupied solely by dwelling houses of a superior description'. They saw the Garden as an opportunity to provide a quality amenity for the area. The Garden formed the first feu, of 21 acres extending between Great Western Road to the steep wooded banks of the Kelvin. However, the urge to exploit the minerals in the area seems to have proved too much for Mr Montgomery as he decided to calcine ironstone on a small island which he formed on the River Kelvin close to the Gardens. It was said that this would "render the garden totally unfit for the objects of the Institution". This and other matters in dispute were resolved and Mathew Montgomery then became a director of the Institution!

Stewart Murray laid out the new Garden, commencing early in 1840 by draining, trenching and manuring the heavy clay soil, and then cropping with potatoes. An area excavated for a pond gave a fine clay which was used to make 300,000 bricks on site. (This pond remained until 1865 when it was filled in as unsightly and a hazard to children, and it is worth noting that the area remains the most badly drained part of the Gardens to this day). The woodland along the river bank was also thinned and the timber used, along with the bricks, in erecting a range of buildings used as a gardeners' bothy, stable and potting and tool sheds.

The glasshouse range was brought from Sandyford and re-erected in 1841 when the Curator's House, designed by the distinguished Glasgow architect, Charles Wilson, was built for Stewart Murray and his large family. The whole plant collection, including many of the established trees, were transferred to the new site, and the whole operation was completed for the official opening on 30 April 1842. Today the Weeping Ash (*Fraxinus excelsior* 'Pendula') planted near the original pond is the only tree identified as having come from the Sandyford Garden. Among those successfully re-established at the time was a Yew tree (*Taxus baccata*) grown from a cutting taken from the then famous Crookston Yew, with Mary Queen of Scots connections. It had first been ceremoniously planted in 1817 with a casket including the names of the original Board of Directors. Unfortunately it did not survive further transplanting in 1889 when the railway tunnel was cut through the Gardens.

Although the original site at Sandyford was sold at a profit which allowed for the purchase of the larger site at Kelvinside, the costs of running the new Garden were greater and the Royal Botanic Institution was always to be in debt. The opening up of the West End was much slower than expected and the Institution was dependent on residents taking up shares. A financial recession also led to a long delay in the projected move by the University to Gilmorehill. Although a lecture theatre - now the Gardens' offices and lecture room - was built, the distance between the Gardens and the Old College remained inconvenient until the eventual move of the University to Gilmorehill in 1870. At about this time John Kibble persuaded the Botanic Institution to enter into an agreement for the transfer and enlargement of his glasshouse at Coulport to the present site. It opened for concerts and meetings in June 1873. John Kibble, and later his assignee John Maxton, organised these, including Rectorial Addresses, but the arrangement was not a long term success. In 1879 the complex leasing arrangement was brought to an end and the Kibble Palace laid out much as it is to-day. To do this, and to replace the by now derelict glasshouse range, a loan of £25,000 was obtained from the City. In the years that followed the Royal Botanic Institution could not even pay interest on the loan and the City became creditors by 1888. However the Gardens were not finally taken over by the City until the passing of the City of Glasgow Act of 1891 which extended the City boundaries. As a result of this the Gardens were opened free to the public, the University's rights to plant material and facilities were maintained, and the Royal Botanic Institution ceased to exist.

Under City ownership the Gardens were extended in area, but industrial pollution soon threatened to repeat the story of the old Physic Garden and the Sandyford site. A good collection of glasshouse plants was maintained but many plants, especially conifers, suffered badly. Long term improvements only became possible as the Clean Air Act of 1956 gradually became effective and in the early 1970s, as a part of funding which led to the opening of the Kelvin Walkway, a small arboretum was established on the site of a coup. This area was a part of the ground which had been taken over at the turn of the century and included what had been a bleaching green. This was at first laid out to form walks as an extension to the Gardens, but within a few years had been abandoned because its relative remoteness made it difficult to maintain to an acceptable standard.

Looking at the densely built West End of today, we are grateful for the inspiration and commitment of those who initiated and developed this green space which as well as its glasshouses with their exotic plants and the botanical collections outside has developed its own unique wild flora and fauna.

Further Reading

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PLANTS GROWING IN A WILD STATE

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This account of the plants recorded as growing in a 'wild state' within the Glasgow Botanic Gardens is part of the Glasgow Natural History Society survey of the Gardens, conducted over a period of three years. During 1994 and 1995 evening field meetings were held on a monthly basis from late spring to early autumn. In addition frequent day-time visits were paid by the author during the years 1994 - 1997. For botanical recording purposes the Gardens are in the Lanarkshire vice-county, V.C. 77.

In total 279 different flowering plants were recorded. Of these 163 (58.4%) are regarded as being native and 116 (41.6%) aliens. Of the latter, 42 (15.1% of the total) are presumed to have arrived by natural dispersal, 14 (5%) to be accidental introductions and 60 (21.5%) to have been originally planted in the Gardens but now spread to another site (Fig 1). In a number of cases it is difficult to be sure of the status but all have been allocated to what is considered to be the most likely, rather than having to include a doubtful category. The 116 aliens have been subdivided further according to their persistence state: 54 are established, 27 are surviving and 35 were of casual occurrence. The definitions of the above categories are those recommended by the Botanical Society of the British Isles (Macpherson, *et al.*, 1996). The complete lists of plants in these categories are given in the appendix.

Site Surveys

The long abandoned railway station, near the main entrance to the Gardens, is noted particularly for the quantity and diversity of cotoneasters. There are 26 individual plants, mostly situated round the peripheral fence in situations indicating spread by birds. These are of nine different kinds, in two cases the only records for the Glasgow area, in one the second and

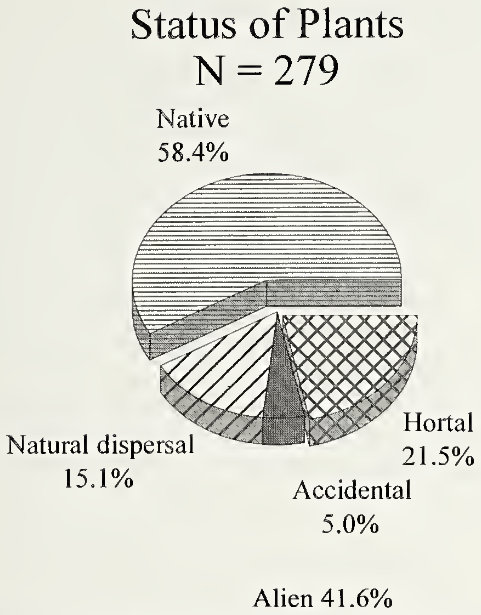

Figure 1. The native or alien status of the plants recorded in a 'wild state' in the Glasgow Botanic Gardens.

another the third local record. Cotoneasters are not a feature of the planting at the Gardens so the plants must be the results of introduction from neighbouring private gardens. There is one seedling of Elaeagnus (*Elaeagnus umbellata*) and this probably did come from a tree within the Gardens. At one corner there is a large patch of Two-spined Acaena (*Acaena ovalifolia*), which is a Pirri-pirri-bur and a feature of a formal bed about two hundred metres away.

Formal beds are almost weed-free, but the locally rare Field Woundwort (*Stachys arvensis*) has occurred and on occasions self-sown plants such as Heath Spotted-orchid (*Dactylorhiza maculata* ssp. *ericetorum*) and the accidentally introduced Springbeauty (*Claytonia perfoliata*) can be seen. The diminutive New Zealand Willowherb *(Epilobium brunnescens*) can usually be found, while the Bronzy Willowherb (*E. komarovianum*) grows at the side of the pond. On a fallow bed, towards the centre of the Gardens, a Birdseye has been tentatively identified as *Gilia inconspicua*, a plant native in the western part of North America. There is no record of this plant having been grown in the Gardens and it may therefore have arrived in the soil of another plant or as a seed contaminant. There are only pre-1930 records of this species occurring as an alien plant in the British Isles (Clement & Foster 1994). There is uncertainty also as to the source of a slender Toadflax (*Linaria amethystea* ssp. *multipunctata)* (Plate 1) a plant of cultivated ground in Spain and Portugal and for which Clement & Foster (1994) give no British records. It is now a widespread weed in the fallow beds. Common Stork's-bill (*Erodium cicutarium*) must be a definite accidental introduction.

Near the Hump Back Bridge the native Wall Lettuce (*Mycelis muralis*) is to be found, a relative rarity in the West of Scotland. Pick-a-back-plant (*Tolmiea menziesii*) is established along the path which runs, on the right bank of the river from the bridge, in a north westerly direction. On both sides of the path there is rough grassland with partial tree canopy. In this area grow the native plants Wood Avens (*Geum urbanum*), Bugle (*Ajuga reptans*), Broad-leaved Helleborine (*Epipactis helleborine*) and Pignut (*Conopodium majus*). Salmonberry (*Rubus spectabilis*) and Thimbleberry (*R. parviflorus*) were originally planted but are now well established. Scottish Laburnum (*Laburnum alpinum*) was also planted and is now suckering. Further along this bank is Purple Toothwort (*Lathraea clandestina*), perhaps the most interesting plant in this habitat (Plate 1). It was first noticed in the Gardens in May 1915 and was also known from the Royal Botanic Garden, Edinburgh, as recorded in the proceedings of the Glasgow Natural History Society for that year. Lee (1933) reported that "it grows on the roots of Privet in the Botanic Gardens where it still occurred on Goat Willow and on nearby Poplars". Thriving colonies may still be seen each spring and the plant is gradually spreading.

The old railway line has Wood Sedge (*Carex sylvatica*) and as introductions, Londonpride (*Saxifraga* x *urbium*), Pink Purslane (*Claytonia sibirica*) and Fringe Cups (*Tellima grandiflora*). The Purple Toothwort has spread down from the bank above. Just to the north of the Kirklee Road Bridge there is a steep grassy bank, the site for Glory-of-the-snow (*Chinodoxa forbesii*) and Meadow Saffron (*Colchicum autumnale*). A path from this area leads to where garden refuse is periodically dumped. The path sides have abundant Small Balsam (*Impatiens parviflora*) and Hedgerow Crane's-bill (*Geranium pyrenaicum*) (Plate 1).

In the neighbourhood of the dump area a number of interesting plants persist. These included Wild Celery (*Apium graveolens*), Fennel (*Foeniculum vulgare*), Dame's-violet (*Hesperis matronalis*), Blue Sow-thistle (*Cicerbita macrophylla)* and Great Quaking-grass (*Briza maxima*). In addition, Giant Leek (*Allium giganteum*), Scorzonera (*Scorzonera hispanica*), Pom-pom Daisies (*Bellis perennis* cv), Meadow Foam (*Limnanthes douglasii*), *Sida hermaphrodita* and a Scabious (*Knautia dipsacifolia*) have occurred on occasions. The record for the last is only the second report of the occurrence of this plant in the British Isles in a 'wild state'.

The steep north-east bank of the river has semi-natural woodland in which grow Wood Melick (*Melica uniflora*), Wood Meadow-grass (*Poa nemoralis*), Hairy-brome (*Bromopsis ramosa*), Great Wood-rush (*Luzula sylvatica*) and Dog's Mercury (*Mercurialis perennis*). At the edge of the path, on this side of the river, there is a colony of Intermediate Enchanter's-nightshade (*Circaea* x *intermedia*). The banks of the River Kelvin are sites for some noteworthy plants. The most interesting natives are Wood Stitchwort (*Stellaria nemorum*), Giant Bellflower (*Campanula latifolia*), Common Valerian (*Valeriana officinalis*), Winter-cress (*Barbarea vulgaris*) and Common Comfrey (*Symphytum officinale*). Round-leaved Saxifrage (*Saxifraga rotundifolia*) is a migrant from upstream. Also alongside the river Giant Hogweed (*Heracleum mantegazzianum*) (Plate 1) can be found , as well as Giant Knotweed (*Fallopia sachalinensis*) and the hybrid *F.* x *bohemica* between it and Japanese Knotweed (*F. japonica*) (Hart *et al* 1997). The rare Highclere Holly (*Ilex* x *altaclerensis*) grows on a steep bank and is considered to be birdsown. A large colony of Rayed Tansy (*Tanacetum macrophyllum*) grows close to the railings between the path and the river just upstream of the Kirklee Road Bridge while Californian Honeysuckle (*Lonicera involucrata*) is to be found on a similar site further downstream. The stretch between the railing and the river in this part has established colonies of Daffodils (*Narcissus* species and cultivars) including Trumpet, Long-cupped and Short-cupped varieties. Strictly speaking Hairy Chervil (*Chaerophyllum hirsutum*) is marginally outwith the Gardens, its site being on the right bank just a little to the east of the Queen Margaret Drive Bridge. It is native in mainland Europe and the only other site for this plant in Great Britain is a grassy roadside verge in Westmorland (Clement and Foster 1994).

The more gently flowing parts of the river have Unbranched Bur-reed (*Sparganium emersum*), Broad-leaved Pondweed (*Potamogeton natans*) and Common Water-starwort (*Callitriche stagnalis*), while Common Duckweed (*Lemna minor*) occurs in muddy pools. Glasshouses have, as accidental introductions, Mind-your-own-business, (*Soleirolia soleirolii*), which also grows outside the buildings particularly at the Kibble Palace, and Procumbent Yellow-sorrel (*Oxalis corniculata*) as well as its bronzy variety (var. *atropurpurea*).

Family Records

It is of interest to examine some of the records according to the family to which they belong. One alien plus 16 native grasses have been recorded within the Gardens. Most are to be found in the rough grassland near the river. The Wood Melick, Wood Meadow-grass and Hairy-brome occur in the wooded areas and Great Quaking-grass persists in the neighbourhood of the dumping area as mentioned above.

Seven species of fern have been recorded. Black Spleenwort (*Asplenium adiantum-nigrum*) grows on walls while the others are in more shady parts of the site. Soft Shield-fern is an intriguing record. One plant grows on a grassy bank above the path which parallels the river. This is a rare fern in the West of Scotland. As there is no other record for either the immediate Glasgow area or for the rest of the Lanarkshire vice-county it is assumed that it has spread from introduced material, probably from the fernery in which there are shield-fern species and varieties.

Three wood-rushes have been noted, the Field Wood-rush (*Luzula campestris*) and the Heath Wood-rush (*L. multiflora*) in grassy areas with the Great Wood-rush in woodland. Only two rushes were recorded, Soft Rush (*Juncus effusus)* in the damper areas and Toad Rush (*J. bufonius*) in the small ditches at the edges of paths. Similarly, two sedges were noted, Common Sedge (*Carex nigra*) in a wet habitat and Wood Sedge along the old railway track.

SUMMARY

It is interesting that native plants comprise almost 60% of the plant species growing in a ‘wild state’ in the Glasgow Botanic Gardens. Of the aliens, approximately equal numbers occurred in the combined group arriving either by natural dispersal or accidental introduction and those which were the result of spread from material deliberately planted in the Gardens. In the alien category 70% are established or surviving. In such a habitat a turnover of hortal casuals (those introduced as the result of gardening activities) is to be expected. As a result of the survey a number of national rarities have been recorded and in one case a new alien record made for the British Isles.

ACKNOWLEDGEMENTS

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APPENDIX

These lists are in the Field Card order as used by the Botanical Society of the British Isles.

Native Plants on Site

Achillea millefolium	Yarrow
Agrostis canina	Common Bent
Ajuga reptans	Bugle
Alchemilla xanthochlora	Intermediate Lady’s mantle
Alliaria petiolata	Garlic Mustard
Allium ursinum	Ramsons
Alnus glutinosa	Alder
Alopecurus geniculatus	Marsh Foxtail
Alopecurus pratensis	Meadow Foxtail
Anisantha sterilis	Barren Brome
Anthriscus sylvestris	Cow Parsley
Arabidopsis thaliana	Thale Cress
Arctium minus	Lesser Burdock
Artemisia vulgaris	Mugwort
Asplenium adiantum-nigrum	Black Spleenwort
Athyrium filix-femina	Lady-fern
Barbarea vulgaris	Winter-cress
Bellis perennis	Daisy
Betula pendula	Silver Birch
Betula pubescens	Downy Birch
Blechnum spicant	Hard Fern
Bromopsis ramosa	Hairy-brome
Callitriche stagnalis	Common Water-starwort
Calystegia sepium	Hedge Bindweed
Campanula latifolia	Giant Bellflower
Capsella bursa-pastoris	Shepherd’s-purse
Cardamine flexuosa	Wavy Bitter-cress
Cardamine hirsuta	Hairy Bitter-cress
Carex nigra	Common Sedge
Carex sylvatica	Wood-sedge
Cerastium fontanum	Common Mouse-ear
Cerastium glomeratum	Sticky Mouse-ear
Chamerion angustifolium	Rosebay Willowherb

Chrysosplenium oppositifolium	Opposite-leaved Golden-saxifrage
Circaea x *intermedia*	Upland Enchanter's-nightshade
Cirsium vulgare	Spear Thistle
Clinopodium vulgare	Wild Basil
Conopodium majus	Pignut
Crataegus monogyna	Hawthorn
Cynosurus cristatus	Crested Dog's-tail
Dactylorhiza maculata ssp. *ericetorum*	Heath Spotted-orchid
Deschampsia flexuosa	Wavy Hair-grass
Digitalis purpurea	Foxglove
Dryopteris affinis	Scaly Male-fern
Dryopteris dilatata	Broad Buckler-fern
Dryopteris filix-mas	Male-fern
Elytrigia repens	Common Couch
Epilobium montanum	Broad-leaved Willowherb
Epilobium obscurum	Short-fruited Willowherb
Epilobium roseum	Pale Willow-herb
Epipactis helleborine	Broad-leaved Helleborine
Fallopia x *bohemica*	Hybrid Knotweed
Festuca gigantea	Giant Fescue
Festuca pratensis	Meadow Fescue
Festuca rubra	Red fescue
Fragaria vesca	Wild Strawberry
Fraxinus excelsior	Ash
Galeopsis tetrahit	Common Hemp-nettle
Galium aparine	Cleavers
Galium saxatile	Heath Bedstraw
Geranium pyrenaicum	Hedgerow Crane'sbill
Geum urbanum	Wood Avens
Gnaphalium uliginosum	Marsh Cudweed
Hedera helix	Ivy
Heracleum sphondylium	Hogweed
Hieracium sabaudum	a Hawkweed
Hieraceum vulgatum	Common Hawkweed
Hyacinthoides non-scripta	Bluebell
Hypericum perforatum	Perforate St. John's-wort
Hypericum tetrapterum	Square-stalked St John's-wort
Hypericum x *desetangsii*	Hybrid St John's-wort
Hypochoeris radicata	Cat's-ear
Ilex aquifolium	Holly
Juncus bufonius	Toad Rush
Juncus effusus	Soft-rush
Lapsana communis	Nipplewort
Lathyrus pratensis	Meadow Vetchling
Lemna minor	Common Duckweed
Leucanthemum vulgare	Oxeye Daisy
Linaria vulgaris	Common Toadflax
Lonicera periclymenum	Honeysuckle
Lotus corniculatus	Common Bird's-foot-trefoil
Luzula campestris	Field Wood-rush
Luzula multiflora	Heath Wood-rush
Luzula sylvatica	Great Wood-rush
Matricaria recutita	Scented Matweed
Melica uniflora	Wood Melick
Mercurialis perennis	Dog's Mercury
Mycelis muralis	Wall Lettuce
Myosotis arvensis	Field Forget-me-not
Papaver rhoeas	Common Poppy
Persicaria bistorta	Common Bistort
Persicaria maculosa	Redshank
Phleum pratense	Timothy
Phyllitis scolopendrium	Hart's-tongue
Pilosella officinarum	Mouse-ear Hawkweed
Plantago major	Great Plantain
Poa annua	Annual Meadow-grass
Poa nemoralis	Wood Meadow-grass
Poa pratensis	Smooth Meadow-grass
Poa trivialis	Rough Meadow-grass
Polypodium vulgare	Polypody
Potamogeton natans	Broad-leaved Pondweed
Potentilla anserina	Silverweed
Potentilla erecta	Tormentil
Primula vulgaris	Primrose
Prunella vulgaris	Selfheal
Prunus padus	Bird Cherry
Pteridium aquilinum	Bracken
Quercus petraea	Sessile Oak
Quercus petraea x *Q robur*	Hybrid Oak
Quercus robur	Pedunculate Oak
Ranunculus acris	Meadow Buttercup
Ranunculus ficaria	Lesser Celandine
Ranunculus repens	Creeping Buttercup
Rubus fruticosus	Bramble
Rubus idaeus	Raspberry
Rubus latifolius	a Bramble
Rumex acetosa	Common Sorrel
Rumex longifolius	Northern Dock
Rumex obtusifolius	Broad-leaved Dock
Sagina procumbens	Procumbent Pearlwort
Salix alba	White Willow
Salix caprea	Goat Willow
Salix caprea .x. *S. cinerea*	Hybrid Willow
Salix cinerea ssp. *oleifolia*	Rusty Willow
Scrophularia nodosa	Common Figwort
Senecio jacobaea	Common Ragwort
Senecio vulgaris	Groundsel
Silene dioica	Red Campion
Sinapis arvensis	Charlock
Sisymbrium officinale	Hedge Mustard
Sonchus arvensis	Perennial Sow-thistle
Sonchus asper	Prickly Sow-thistle
Sonchus oleraceus	Smooth Sow-thistle
Sorbus aucuparia	Rowan
Sparganium emersum	Unbranched Bur-reed
Spergula arvensis	Corn Spurrey
Stachys arvensis	Field Woundwort
Stachys sylvatica	Hedge Woundwort
Stellaria nemorum	Wood Stitchwort
Symphytum officinale	Common Comfrey
Tanacetum vulgare	Tansy
Taraxacum cordatum	a Dandelion
Taraxacum duplidentifrons	a Dandelion
Taraxacum exactum	a Dandelion
Teucrium scorodonia	Wood Sage
Tragopogon pratensis ssp. *minor*	Goat's-beard
Trifolium dubium	Lesser Trefoil
Trifolium pratense	Red Clover
Trifolium repens	White Clover
Tripleurospermum inodorum	Scentless Mayweed

Tussilago farfara	Colt's-foot
Ulex europaeus	Gorse
Ulmus glabra	Wych Elm
Urtica dioica	Common Nettle
Valeriana officinalis	Common Valerian
Verbascum thapsus	Great Mullein
Veronica arvensis	Wall Speedwell
Veronica agrestis	Green Field-speedwell
Veronica chamaedrys	Germander Speedwell
Veronica officinalis	Heath Speedwell
Veronica serpyllifolia	Thyme-leaved Speedwell

Natural Dispersal to Site

Acer platanoides	Norway Maple
Acer pseudoplatanus	Sycamore
Aegopodium podagraria	Ground-elder
Aesculus hippocastanum	Horse-chestnut
Brassica napus	Rape
Brassica rapa	Wild Turnip
Buddleja davidii	Butterfly-bush
Cicerbita macrophylla	Blue Sow-thistle
Claytonia sibirica	Pink Purslane
Cotoneaster boisianus	a Cotoneaster
Cotoneaster bullatus	Hollyberry Cotoneaster
Cotoneaster franchetii	Franchet's Cotoneaster
Cotoneaster frigidus	Tree Cotoneaster
Cotoneaster hjelmqvistii	Hjelmqvist's Cotoneaster
Cotoneaster horizontalis	Wall Cotoneaster
Cotoneaster lacteus	Late Cotoneaster
Cotoneaster salicifolius	Willow-leaved Cotoneaster
Cotoneaster simonsii	Himalayan Cotoneaster
Cotoneaster x *watereri*	Waterer's Cotoneaster
Cymbalaria muralis	Ivy-leaved Toadflax
Epilobium ciliatum	American Willowherb
Fagus sylvatica	Beech
Fallopia japonica	Japanese Knotweed
Heracleum mantegazzianum	Giant Hogweed
Hesperis matronalis	Dame's-violet
Hieracium pseudorigens	a Hawkweed
Ilex x altaclerensis	Highclere Holly
Impatiens glandulifera	Indian Balsam
Lunaria annua	Honesty
Lysimachia punctata	Dotted Loosestrife
Myrrhis odorata	Sweet Cicely
Ribes nigrum	Black Currant
Ribes sanguinium	Flowering Currant
Ribes uva-crispa	Gooseberry
Saxifraga rotundifolia	Round-leaved Saxifrage
Sorbus aria	Common Whitebeam
Sorbus intermedia	Swedish Whitebeam
Symphytum x *uplandicum*	Russian Comfrey
Tanacetum parthenium	Feverfew
Tanacetum vulgare	Tansy
Tellima grandiflora	Fringe-cups
Tolmiea menziesii	Pick-a-back-plant

Accidental Introduction to Site

Claytonia perfoliata	Springbeauty
Epilobium brunnescens	New Zealand Willowherb
Epilobium komarovianum	Bronzy Willowherb
Erodium cicutarium	Common Stork's-bill
Gilia inconspicua	a Birdseye
Lathraea clandestina	Purple Toothwort
Linaria amethystea ssp. *multipunctata*	a Toadflax
Lycopersicon esculentum	Tomato
Melastomaceae sp.	(a mainly tropical family of trees and shrubs)
Oxalis corniculata	Procumbent Yellow-sorrel
Oxalis corniculata var. *atropurpurea*	Bronzy Procumbent Yellow-sorrel
Solanum tuberosum	Potato
Soleirolia soleirolii	Mind-your-own-business
Vicia sativa ssp. *segetalis*	a Common Vetch

Originally Planted in the Gardens but spread to site

Acaena ovalifolia	Two-spined Acaena
Alchemilla mollis	Soft Lady's-mantle
Allium paradoxum	Few-flowered Leek
Allium giganteum	Giant Leek
Alstromeria aurea	Peruvian Lily
Apium graveolens	Wild Celery
Aquilegia vulgaris	Columbine
Aruncus dioicus	Buck's-beard
Aster novi-belgii	Michaelmas-daisy
Bellis perennis (cultivar)	Pom-pom Daisy
Briza maxima	Great Quaking-grass
Campanula rapunculoides	Creeping Bellflower
Centaurea montana	Perennial Cornflower
Chaerophyllum hirsutum	Hairy Chervil
Chinodoxa forbesii	Glory-of-the-snow
Colchicum autumnale	Meadow Saffron
Collomia linearis	(no English name)
Convallaria majalis	Lily-of-the-valley
Elaeagnus umbellata	Elaeagnus
Eupatorium cannabinum	Hemp-agrimony
Fallopia sachalinensis	Giant Knotweed
Foeniculum vulgare	Fennel
Fragaria x *ananassa*	Garden Strawberry
Hedera colchica	Persian Ivy
Hedera 'Hibernica'	Irish Ivy
Hyacinthoides hispanica	Spanish Bluebell
Hyacinthoides hispanica x *non-scripta*	Hybrid Bluebell
Impatiens parviflora	Small Balsam
Knautia dipsacifolia	a Scabious
Laburnam alpinum	Scottish Laburnam
Lamium maculatum	Spotted Dead-nettle
Ligustrum ovalifolium	Garden Privet
Limnanthes douglasii	Meadow Foam
Linaria repens	Pale Toadflax
Lonicera involucrata	Californian Honeysuckle
Lysimachia punctata	Dotted Loosestrife
Meconopsis cambrica	Welsh Poppy
Mimulus x *robertsii*	Hybrid Monkeyflower
Myosotis sylvatica	Wood Forget-me-not (garden variety)
Narcissus (Div. 1)	Trumpet Daffodil
Narcissus (Div. 2)	Long-cupped Daffodil
Narcissus (Div. 3)	Short-cupped Daffodil
Nepeta cf *racemosa*	a Cat-mint

Papaver somniferum	Opium poppy
Pilosella aurantiaca ssp. *carpathicola*	Fox-and-cubs
Polystichum setiferum	Soft Shield-fern
Ribes sanguineum	Flowering Currant
Rhododendron ponticum	Rhododendron
Rubus cockburnianus	White-stemmed Bramble
Rubus parviflorus	Thimbleberry
Rubus spectabilis	Salmonberry
Saxifraga x *urbium*	Londonpride
Scorzonera hispanica	Scorzonera
Sedum rupestre	Reflexed Stonecrop
Sida hermaphrodita	(no English name)
Sorbus latifolia	"Broad-leaved" Whitebeam
Tanacetum macrophyllum	Rayed Tansy
Taxus buccata	Yew
Vinca minor	Lesser Periwinkle
Viola (cultivar)	Garden Pansy

TREES OF GLASGOW BOTANIC GARDENS

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The maritime British climate is quite benign and Scotland is eminently suited for the cultivation of most temperate tree species. Indeed many of them grow better here than they do in their natural range. In October 1984 J. Miller, a tree measuring enthusiast from Ross & Cromarty, measured the heights and girths of trees in the Glasgow Botanic Garden (30 heights and 58 girths). As part of the Glasgow Natural History Society survey of the Gardens during 1994-97, re-measurement of these specimens was carried out with a view to observing tree growth over a ten year period. Altogether 60 heights and girths were measured. If these measurements were to be repeated in the 21st century the growth potential of different species in this area might be assessed over a lengthy period. Of particular interest is a *Betula jacquemontii* which, at 17m high and 1.33m girth, is arguably one of the biggest of its kind in Great Britain. Measurements are shown in Table 1. and other species mentioned in the text are listed in Table 2.

In the Gardens are to be found some 87 different species or varieties quoted as rare or not mentioned at all by Mitchell in "Trees of Britain" (1996) and in the "Royal Horticultural Society's Encyclopaedia of Plants & Flowers" (1989).

Sections of the Garden of silvicultural interest.

Arboretum

The best represented groups of the above 87 specimens are alder (*Alnus* spp.), birch (*Betula* spp.) and *Sorbus* spp. and most of these specimen trees are to be found in the arboretum with the alders growing well in the moist conditions at the foot of the slope next to the River Kelvin and the birches and rowans planted higher up the slope where the soil is better drained. Rare maples (*Acer* spp.) are also to be found, especially near the Kirklee gate.

Autumn and winter are the best seasons to observe these trees; the former season for displaying fruits and the autumnal colouring of the foliage and the latter for displaying their spectacular barks. Red-fruited rowans include *Sorbus commixta* and *S. sargentiana;* white-fruited ones include *S. cashmiriana, S. forrestii* and *S. prattii; S. hupehensis* and *S. vilmorinii* have pink fruits; and *S. rehderiana* 'Joseph Rock' is yellow-fruited. *Sorbus* species with entire leaves are referred to as whitebeams, their leaf undersurface being densely white pubescent. Hybridisation provides considerable genetic interest within the genus and examples of the triploids *S. arranensis* and *S. bristoliensis* may be found. The North American maples red *(A. rubrum)*, silver *(A. saccharinum)* and sugar *(A. saccharum)* provide outstanding autumn tints whilst the Japanese maple *A. palmatum* 'Dissectum atropurpureum' produces interesting leaf shapes as well as colour. For attractive bark the red snakebark maple *(A. capillipes)*, the snakebark maple *(A. rufinerve)* and the peeling brown paperbark maple *(A. griseum)* are hard to beat. The Japanese snakebark maples are green in colour with white striations. The peeling bark of the Himalayan birches varies from white to brown and there is thought to be a correlation between bark colour and climate; the white-barked trees grow at high altitude with high light intensity and low temperatures in dry zones whereas the brown-barked birches grow where rainfall is high.

David Douglas collection

This collection in the arboretum contains various trees, shrubs and herbaceous plants introduced to this country during the first half of the 19th century by the plant explorer David Douglas (1799 -1834), who had worked in this garden for a while under William Hooker, later director at Kew. Douglas was sent to North West America by the Horticultural Society on the recommendation of Hooker and his expeditions returned the seed of many trees, some of which are represented in the collection in the Gardens.

The 3-needled Big-cone pine *(Pinus coulteri)* has needles 25-30 cm. long and cones up to 2kg., the biggest cones of any pine. It is found rarely in this country. By contrast Sitka spruce *(Picea sitchensis)* is regarded by foresters as the 'designer tree'. It is widely planted in poor upland acidic peat soils where it can grow rapidly to produce a marketable stand of timber from areas that are otherwise non-productive. Other Douglas introductions are younger and of smaller stature. These include the Grand fir *(Abies grandis),* amongst the tallest and fastest growing trees in this country; the Noble fir *(A. procera)*, a big tree with distinctive blue-grey foliage; Western yellow pine *(Pinus ponderosa)*, a 3-needled pine that grows fast in well drained acid soils; Douglas fir *(Pseudotsuga menziesii)* that rapidly grows into an enormous tree. Also of interest in this area, but not a Douglas introduction, is *Salix scouleriana*, a willow named after a local 19th century naturalist of some repute, John Scouler (1804-1871), who visited the Galapagos before Charles Darwin (1809 - 1822) and whose herbarium and geological collection are in the Art Gallery & Museum, Kelvingrove.

Fossil plant area

The dawn redwood *(Metasequoia glyptostroboides)* had been known from 20 million year old Japanese, Pliocene fossils when it was discovered in the wild in 1941 by a Chinese forester in Hupeh province, where the deciduous foliage was

Table 1. Tree measurements made in Glasgow Botanic Gardens, 1984 - 1995.

Reference*			Height (m.)		Girth (m.)	
	Conifers		1984	1995	1984	1995
188-2 29	*Araucaria araucana*	Chile pine	13	13	1.24	1.5
167-6 50	*Ginkgo biloba*	Maidenhair tree		6		0.27
190-18 85	*Metasequoia glyptostroboides*	Dawn redwood	10	12	0.67	1.37
188-9 63	*Pinus nigra* var.*nigra*	Austrian pine	10	12	0.67	2.04
179-31 17	*P. wallichiana*	Bhutan pine		16	1.18	1.38
188-14 60	*Sciadopytis verticillata*	Umbrella pine		7		0.72
	Broadleaves					
157-7 55	*Acer palmatum* 'Dissectum Roseo-marginatum'			5.4		0.32
198B-1 77	*A. pseudoplatanus*	Sycamore	14	16	1.57	1.68
89	*A. saccharinum*	Silver maple			2.15	
190-9 84	*Aesculus hippocastanum*	Horse chestnut	17	17	2.39	2.54
159-7 58	*Ailanthus altissima*	Tree of Heaven		15	0.98	1.26
179-26 12	"	"		11	0.66	0.90
198B-306 8	*Betula jacquemontii*	White-barked Himalayan birch	14	17	1.10	1.33
179-9 19	*Carpinus betulus*	Hornbeam		18	2.03	2.06
190-15 31	"	"	11	12	1.77	2.04
178B-5 13	*C. betulus* 'Heterophylla'	"		12	1.31	1.38
161-8 51	*Catalpa bignonioides*	Southern catalpa		5.5		0.31
173-19 43	*Cedrela sinensis*	Chinese cedar	9	10	1.42	1.63
204-1 27	*Cotoneaster frigidus*	Tree-cotoneaster	11	12	1.35	1.36
197-24 37	*Crataegus x prunifolia*	Broadleaf Cockspur thorn		4		0.25
167-9 49	*Eucryphia x nymansensis*	Hybrid eucryphia		10		0.47
159-4 48	*Euodia hupehensis*	Euodia		11	1.2	1.85
203-3 82	*Fagus sylvatica*	Beech	19	20	2.33	2.44
161-7 6	"	'Asplenifolia' Fern-leaf beech		12		2.72
161-15 52	" 'Dawyck'	Dawyck beech		5.2		0.17
190-13 86	" 'Purpurea'	Copper beech	14	15	2.32	2.46
197-26 70	*Fraxinus excelsior*	Common ash	20	20	2.8	2.96
197-30 71	"	"	22	22	2.7	2.86
193-10 36	"	"	18	18	1.6	1.78
173-15 73	" 'Diversifolia'	Single leaf ash	14	15	1.0	1.1
161-1 9	" 'Pendula'	Weeping ash	14	14	2.2	2.32
190-31 81	*F. ornus*	Manna ash	12	13	2.2	2.2
158-1 46	*Kalopanax pictus*	Prickly castor oil	10	11	1.4	1.87
178A-4 10	*Liriodendron tulipifera*	Tulip tree		13	0.8	1.05
167-14 2	*Nothofagus antarctica*	Antarctic beech		8		0.85
159-3 47	*Phellodendron amurense*	Amur Cork tree		12	0.9	1.72
159-5 59	"	"		14	0.8	1.07
179-49 15	*Platanus x acerifolia*	London plane		15	2.3	2.49
198B-34 34	"	"		19	2.1	2.14
161-10 5	"	"		18		3.20
202-9 30	*Populus canescens*	Grey poplar	20	20	1.9	2.08
157-13 54	*P. lasiocarpa*	Chinese poplar		9.5	0.88	1.02
167-16 40	*Prunus avium*	Gean (Wild cherry)		7		1.10
178A-5 11	*P. avium* 'Plena'	Double gean		11	1.23	1.48
163-3 39	"	"	8	11	1.09	1.28
183-2 62	*P. cerasifera*	Cherry plum		8	0.87	1.40
190-4 80	*Pyrus communis*	Common pear		9	0.47	0.77
161-2 8	*Quercus cerris*	Turkey oak	14	16	2.18	2.35
161-12 4	"	"		12		2.31
161-5 7	*Q. frainetto*	Hungarian oak	20	20	1.96	2.30
201-19 25	*Q. velutina*	Black oak	18	18	1.73	2.15
198B-24 26	*Salix alba*	White willow	13	14	1.29	1.56
76	*S. fragilis*	Crack willow	22	22	4.01	4.30
188-1 28	*Sorbus aria*	Whitebeam		11	1.42	1.57
179-6 22	*S. domestica* var.*pyriformis*	True service tree		14	1.57	1.65
202-10 83	*S. intermedia*	Swedish whitebeam		12	1.8	1.9
202-12 74	"	"		11	1.8	1.9
179-23 21	*S. torminalis*	Wild service tree		13	1.43	1.59
190-1 79	*Tilia x europaea*	Common lime	17	17	1.55	1.69
170B-30 69	*T.* 'Petiolaris'	Silver pendent lime		18		2.39
179-3 87	*Ulmus glabra* 'Camperdownii'	Elm	8	8	1.15	1.2

The first part relates to the Glasgow Botanic plot number and individual tree; the second number is J. Miller's notation.

being used as cattle fodder. Since then it has been planted in most arboreta and it is fast growing in wet, sheltered hollows as here in the Gardens. One specimen here has grown from 10m to 12m in 10 years. The Katsura tree *(Cercidiphyllum japonicum)* is the largest hardwood in Japan (32m.) where it produces fine, lightweight timber used for carving very fine detail. It is botanically primitive and ancient, having male and female flowers on different trees. It was introduced about 1864 and is grown here for its great display of autumn colours. Like the previous two species the Chinese wing-nut *(Pterocarya stenoptera)* grows best in the kind of damp fertile soils where it is found in the Gardens. Fossils are found in rocks of the late Tertiary era. It suckers vigorously and is producing a typical thicket. The 50 cm. long female catkins are particularly attractive in summer.

Main area of the Garden

Between the Arboretum and the Kirklee gate are a number of horse chestnuts *(Aesculus* spp.). The common horse chestnut *(A. hippocastanum)* is native to Albania and N. Greece from where it was introduced to Scotland in the 1650's. Most of the species in the genus are N. American where they are known as buckeyes, since their glossy brown conkers resemble the eyes of a deer. The yellow buckeye (*A. flava)* is one of the few yellow-flowered members of this family and is found in this part of the Gardens. Near the Kirklee gate is to be found a 12m. Himalayan tree cotoneaster *(C. frigidus),* the only tree-sized member of this genus. It is characterised by long vertical sprouts growing from the bole and the bright red fruits are prominent in late autumn. A silver pendent lime *(Tilia* 'Petiolaris'*)* some 18m. high grows near the top of the riverside path. This tree is unknown in the wild and is considered to be a cultivar. Trees are grafted mostly onto the broad-leafed lime. It is a splendid sight with the slightest breeze causing the leaves with their silver pubescent undersides and long leaf stalks to flutter.

The manna ash *(Fraxinus ornus)* originates in southern Europe and western Asia and is found in the flagpole area. It is a fine specimen over 2m. in girth and in May is laden with creamy white plumes of scented blossom. Hence this tree is insect pollinated, unlike the wind pollinated common ash, on to which rootstock the manna ash is grafted. In Sicily this tree is tapped for 'manna', the sap which contains mannitol, an alcohol used as a sugar substitute in diabetic foods. Between the south side of the main lawn and Great Western Road is to be found a weeping ash (*F. excelsior* 'Pendula') over 2 m. in girth, which was transferred from the earlier garden at Sandyford to its present location in 1841. This tree is grafted at 2 metres. A specimen of the single-leafed ash (*F. excelsior* 'Diversifolia') 12m. high, is located in the border outside the visitors' centre. This tree is occasionally found in the wild but infrequently in cultivation. With its simple leaves it is quite unlike other members of the ash genus which possess compound leaves.

Behind the herb garden in the SW corner of the Kibble Palace a few unusual specimens are to be found. The Chinese Euodia *(Euodia hupehensis)* was introduced from C. China in 1908. It has no bud scales and the leaf overwinters folded tightly and covered with red brown hairs. It is 11m. high. The prickly castor-oil tree *(Kalopanax pictus)* is also 11m. high. Its leaves are maple-like and the bole has many short spines. It is scarce in cultivation. The rare Amur cork tree *(Phellodendron amurense)* was introduced from N. China in 1856. It has small, naked hairy buds hidden in summer by the leaf stalks and like the Euodia belongs to the Rue family (Rutaceae). It is 14m. high. Finally in this area (at 15m.) and also near the Saltoun gate are specimens of the tree of heaven *(Ailanthus altissima)* introduced from N. China in 1751 by Pere d'Incarville. Although the fruits are keys and its leaves pinnate like those of ash, it belongs to a different, tropical family. On account of the foul smelling male flowers it was first named the stinking ash.

Near the BBC gate is to be found Adam's Laburnum, a strange graft hybrid or chimera, a mixture of the common broom *(Cytisus purpurea)* in the outer layer and common laburnum *(Laburnum anagyroides)* in the inner layer, created originally by chance in 1825 in Paris. This + *Laburnocytisus adamii* produces flowers of each species as well as some that are half way between the two.

Across from the chimera and near the new visitors' centre are two further trees of interest. Firstly is a 10m. high specimen of the Chinese cedar *(Cedrela sinensis).* Not a conifer, this rare tree is called 'cedar' because its scented timber was used for cigar boxes and such trees were originally called 'cedars'. Lastly is a tree which produces the climax of summer flowering in the Gardens - *Eucryphia x nymansensis*, an evergreen 10m. high and covered with a mass of beautiful 6cm. white flowers with a central core of yellow stamens in early September. This hybrid between two S. American species was raised in 1915 at Nymans in Sussex.

Table 2. Other trees mentioned in the text

Conifers	
Abies grandis	Grand fir
A. procera	Noble fir
Picea sitchensis	Sitka spruce
Pinus coulteri	Big-cone pine
P. ponderosa	Western yellow pine
Pseudotsuga menziesii	Douglas fir
Broadleaves	
Acer capillipes	Red snake-bark maple
A. griseum	Paper-bark maple
A. rubrum	Red maple
A. rufinerve	Grey-budded snake-bark maple
A. saccharum	Sugar maple
Aesculus flava	Yellow buckeye
Cercidiphyllum japonicum	Katsura tree
+*Laburnocytisus adamii*	Adam's laburnum
Pterocarya stenoptera	Chinese wing-nut
Salix scouleriana	Scouler's willow
Sorbus arranensis	Arran whitebeam
S. bristoliensis	Bristol whitebeam
S. cashmiriana	Kashmir rowan
S. commixta	Japanese rowan
S. forrestii	Forrest's rowan
S. hupehensis	Hupeh rowan
S. rehderiana 'Joseph Rock'	

Conclusion

As in all gardens trees provide the backbone to the design. They add a third layer to the structure above the herb and shrub layers and provide habitats for wildlife, particularly birds, and also a plethora of invertebrates, mainly because of the food and cover provided. They provide great variety, especially different shapes, colours and textures as described previously; but above all they perfectly reflect the changes of the seasons.

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BIRDS FOR ALL SEASONS

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After the plants the most obvious living things to be seen in the Glasgow Botanic Gardens are birds. Their variety, numbers and changes in populations reflect the quality of the environment and provide a useful monitor of its health, improvement or deterioration. The beauty, behaviour and song of birds also gives much interest and pleasure to visitors to the Gardens.

The following observations are based on numerous visits, each one lasting about an hour usually from about 10.00 a.m., over a period of three years (April 1994-March 1997). The majority of these where made by Norman Grist, with additional visits by Ian McCallum. Information from reports by Russell McMillan (RM) and other reliable witnesses are also included. Often birds were identified first, or even only, by their characteristic song, but others were sighted using binoculars where necessary. Since not all birds present would have been seen or heard on any one occasion, the records indicate minimum populations. Complete species lists are shown in Table 1, and the details from each visit are preserved on files in the Art Gallery & Museum, Kelvingrove.

Three species of the crow family (Corvidae) were seen. Magpies were always present, conspicuous and often noisy, nesting and breeding in tall trees, and foraging on the ground. The peak number was 8 (July 1996), more often 3 or 4. Carrion Crows were also seen and heard on most visits, less often on the ground but also nesting in the taller trees. The peak number was 6 (April 1994), more usually 2 or 3. Although residents in Dawsholm park not far away, Jackdaws were only once encountered, a group of 4 in January 1997, and Rooks were not observed, although they have been reported in former years.

Three species of birds of prey (raptors) were recorded. Tawny Owls were not observed in daylight, but are resident breeders hunting and calling at dusk and by night. A Sparrowhawk was seen only once, November 1995, but was reported by others as occasionally hunting in the grounds, once during the survey period having brought down a pigeon on a path. They breed in the district and hunt over territory which includes the Gardens. Kestrels likewise were rarely seen, one or two over-flying the Gardens in 1994 and 1996. These elegant birds also breed in the area and include the Gardens in their hunting territory.

Six species of water-associated birds were seen, mainly on the river Kelvin. One Heron was often seen stalking in the river in July & October 1996, sometimes by the fish-ladder near the weir below Queen Margaret bridge. Kingfishers were seen infrequently (one or two twice in 1994 and once in 1996) but these fast, colourful fish-hunters have several territories on the Kelvin below the Gardens, breeding there and higher up the river - a tribute to its improved water quality. Goosanders were not reported during previous ornithological surveys (1894, 1901, 1966-71-85 listed below) but were regular winter visitors from October to April during our survey (Plate 2 and Fig. 1). These birds also reflect improved water quality and fish numbers. Up to six of these handsome, fish-eating, saw-billed birds could be seen on the river at one time. Most of them were "redheads" (females or young,males) with one or two mature males in full breeding plumage. Their fast cruising, diving, underwater swimming and rapid flight are impressive. They leave to breed in summer, nesting in holes in trees or on the ground away from disturbance near lochs or rivers, perhaps in Scotland or even Scandinavia. We have no specific information for these River Kelvin visitors. Mallards were always numerous (peak 50 in January, 1997) being residents and breeding in trees, hollows, or near the river, active and enjoying scraps thrown by visitors from the hump-back bridge. Almost always one or two Moorhens were seen or heard on the river or its banks, sometimes two pairs (maximum 8 including young, May 1995). A single Mute Swan spent several months from May to September, 1996, on the Kelvin near the bridge. Surprisingly, no Dipper was recorded, though an occasional sighting has been made by others, and no waders or divers were present, the habitat being unsuitable. Coots also were not seen, although they are resident not far away on the Forth Clyde canal. We encountered no Cormorant although one had been seen fishing near the weir just before our survey began.

Resident insect-eaters (insectivores) were the most numerous group with 16 species. Blackbirds, Robins, Chaffinches, and Blue Tits were always present and numerous with peak numbers being Blackbird 18 (June 1995), Robin 19 (Sept. 1996), Chaffinch 21 (March 1996), Blue tit 17 (Feb. 1996).

All were happy to accept crumbs, crushed peanuts etc. from visitors. Great Tits were usually seen or heard, probably always present, with peak numbers 10 (April 1995). Coal Tits, less conspicuous, fast-moving little birds were often but not always encountered, 3 being present in January 1995. Parties of Long-tailed Tits numbering at least 4 (November 1996), and 6 (December 1995) were occasionally seen and heard, moving actively along the lower tree canopy. Wrens were common breeding birds, tiny and more often heard in cover than seen, but occasionally deafening in springtime at close range. Peak numbers identified were 12 (April 1995). Dunnocks (Hedge Sparrows), inconspicuous little birds, were often seen or heard in the Gardens, peak numbers 4 (May 1994 and 1995). Mistle Thrushes, big, bold songsters, were sometimes encountered, usually solitary, up to 5 in March 1996. The Song Thrush, a species in decline throughout the country, was not often observed, usually a singleton (peak 3 in 1994). Greenfinches are common in gardens in the surrounding area and were often but by no means always noticeable, breeding in small numbers but up to 12 in April 1995. Bullfinches were rarely detected (just 2 in July 1994), as were Pied Wagtails (one in July 1994 & November 1995), also Treecreepers, inconspicuous, agile birds which hunt in spurts up the rough bark of mature trees (one in October 1994 & January 1995). Starlings were not so common as might be expected, foraging in small parties of 8 (May 1994), 10 (May 1995), and 4 (June 1996). Only one Grey Wagtail has been seen, in March 1997. Woodpeckers were not actually observed by us, but hammering was heard nearby in March-April 1997, and a reliable source confirmed the presence of a Great Spotted Woodpecker in the Gardens that April. Since the end of our 'official' recording period a woodpecker has been seen and heard on several occasions.

Three migrant insectivore birds have been recorded during this survey. A few Willow Warblers visit the Gardens briefly (Plate 2 and Fig.1) in spring (April) and autumn (August) in passage to and from summer breeding territories (up to 5 in August, 1996). They are most noticeable from their characteristic, delicate warbling song. Swifts are summer visitors to Glasgow (May to August) and occasionally flew over the gardens, a party of 8 being seen in March 1996. Redwings, insectivorous in the summer in their Scandinavian breeding areas, visit Glasgow in winter but feed on berries at this season. Occasional parties foraged in the Gardens (24 in March, 1996). Their migrating flocks reach Britain in company with Fieldfares, our other 'winter thrushes', which were reported in the Garden in 1996 by RM who also in the same year saw a young male Blackcap (Blackcaps have in recent years become winter visitors to Glasgow).

Three species of seed eaters were seen. Feral Pigeons (the "town pigeons" - multicoloured descendants of Rock Doves) are by far the most numerous birds in the Gardens, exploiting the crumbs and scraps fed to them by visitors there and in nearby areas. Hundreds were regularly present (at least 500 in April 1995), often resting together on the roofs of the glasshouses or foraging on the grass or paths near people offering bread. Woodpigeons, large, plump birds with white neck 'chevron' markings, were also always present, nesting high in trees, numbering up to 22 (March 1997). Collared Doves (small and sleek, with black neck half collar) are common breeding residents in the surrounding area, but were rarely seen within the Gardens (two in Dec. 1994 & Sept. 1995, one in 1996-7 up to April).

Waxwings probably visited the Gardens as well as they were seen regularly in many areas in Glasgow during their recent winter invasions from Scandinavia, but were not actually recorded in the survey. Other visitors to Glasgow include Goldfinches which occasionally twitter through the local treetops in southbound autumn passage but were not seen in the Gardens. House Sparrows have become scarce in much of Britain, including the area around the Gardens, and were not encountered in our survey, though small pockets of sparrows persist in several other places in urban Glasgow. Three species of gulls were recorded in the survey on the water, grass or roofs: Lesser Black-backed Gull (occasional: 3 in June 1996); Herring Gull (occasional: 2 in December 1994), and Black-headed gull (rare: 5 in December 1994).

Comparison with the earlier records of about a century ago shows that of the total 72 species recorded 28 have been present throughout the period. Twenty-two have been lost, that is not recorded recently. These are largely birds of rural countryside, moorlands and woodlands, and many are in decline throughout Britain. Local factors no doubt include urban development and the increased distance between the Gardens and open country or farmland and changes in agricultural practice. There is also the possibility of increased nest-robbing by the many grey squirrels encouraged by handouts from visitors. On the other hand, 13 species have been gained, that is not recorded in the 1894-1901 reports. These include Heron, Mute Swan, Mallard, Kingfisher (first noted in 1985), and most recently the over-wintering Goosanders, reflecting improved water quality of the formerly heavily polluted River Kelvin which can now support more fish and other aquatic animals and plants. The Woodpecker also, surprisingly, seems to be a recent gain. Nine listed species not noted during the earliest surveys nor during our recent one include Pochard (seen 1982), Tufted duck, Coot, Dipper, Snipe, Waxwing, Whinchat (seen 1975), Goldcrest (seen 1972) and Brambling. A list of the birds recorded from different surveys over the years is shown in the list below.

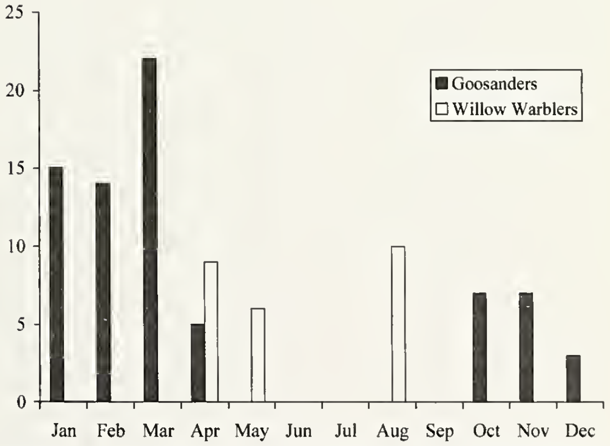

Figure 1. Total numbers of Goosanders and Willow Warblers recorded in the Glasgow Botanic Gardens during the period April 1994 - March 1997.

Table 1. Bird Species recorded in Glasgow Botanic Gardens in 1994-1997 and in earlier surveys (1966-85 and 1894-1901 - see footnotes)

Survey period		1994-97	1966-85a	1894-1901b
Grey heron	*Ardea cinerea*	+	+	o
Mute swan	*Cygnus olor*	+	+	o
Mallard	*Anas platyrhynchos*	+	+	o
Pochard	*Aythya ferina*	o	+	o
Tufted duck	*Aythya fuligula*	o	+	o
Goosander	*Mergus merganser*	+	o	o
Sparrowhawk	*Accipiter nisus*	+	+	+
Kestrel	*Falco tinnunculus*	+	+	o
Corncrake	*Crex crex*	o	o	+
Moorhen	*Gallinula chloropus*	+	+	+
Coot	*Fulica atra*	o	+	o
Lapwing ("Peewit")	*Vanellus vanellus*	o	o	+
Snipe	*Gallinago gallinago*	o	+	o
Common sandpiper	*Actitis hypoleucos*	o	o	+
Black-headed gull	*Larus ridibundus*	+	+	+
Lesser black-backed gull	*Larus fuscus*	+	+	o
Herring gull	*Larus argentatus*	+	+	o
Feral pigeon (Rock dove)	*Columba livia*	+	+	o
Woodpigeon	*Columba palumbus*	+	+	+
Collared dove	*Streptopelia decaocto*	+	+*	o
Cuckoo	*Cuculus canorus*	o	o	+
Tawny owl	*Strix aluco*	+	+	o
Swift	*Apus apus*	+	+	+
Kingfisher	*Alcedo atthis*	+	+	o
Great spotted woodpecker	*Dendrocopos major*	+**	o	o
Sand martin	*Riparia riparia*	o	o	+
Swallow	*Hirundo rustica*	o	o	+
Meadow pipit	*Anthus pratensis*	o	o	+
Yellow wagtail	*Motacilla flava*	o	+	+
Grey wagtail	*Motacilla cinerea*	+	+	+
Pied wagtail	*Motacilla alba*	+	+	+
Waxwing	*Bombycilla garrulus*	o	+	o
Dipper	*Cinclus cinclus*	o	+	o
Wren	*Troglodytes troglodytes*	+	+	+
Dunnock	*Prunella modularis*	+	+	+
Robin.	*Erithacus rubecula*	+	+	+
Redstart	*Phoenicurus phoenicurus*	o	o	+
Whinchat	*Saxicola rubetra*	o	+	o
Stonechat	*Saxicola torquata*	o	o	+
Blackbird	*Turdus merula*	+	+	+
Fieldfare	*Turdus pilaris*	o	o	+
Song thrush	*Turdus philomelos*	+	+	+
Redwing	*Turdus iliacus*	+	+	+
Mistle thrush	*Turdus viscivorus*	+	+	+
Whitethroat	*Sylvia communis*	o	+	+
Garden warbler	*Sylvia borin*	o	o	+
Blackcap	*Sylvia atricapilla*	o	o	+
Wood warbler	*Phylloscopus sibilatrix*	o	o	+
Chiffchaff	*Phylloscopus collybita*	o	o	+
Willow warbler	*Phylloscopus trochilus*	+	+	+
Goldcrest	*Regulus regulus*	o	+	o
Spotted flycatcher	*Muscicapa striata*	o	+	+
Long-tailed tit	*Aegithalos caudatus*	+	+	o
Coal tit	*Parus ater*	+	+	+
Blue tit	*Parus caeruleus*	+	+	+
Great tit	*Parus major*	+	+	+
Treecreeper	*Certhia familiaris*	+	+	+
Magpie	*Pica pica*	+	+	+
Jackdaw	*Corvus monedula*	+	o	+
Rook	*Corvus frugilegus*	o	+	+
Carrion/Hooded crow	*Corvus corone*	+	+	+
Starling	*Sturnus vulgaris*	+	o	+
House sparrow	*Passer domesticus*	o	+	+
Chaffinch	*Fringilla coelebs*	+	+	+
Brambling	*Fringilla montifringilla*	o	+	o
Greenfinch	*Carduelis chloris*	+	+	+
Goldfinch	*Carduelis carduelis*	o	+	+
Linnet	*Carduelis cannabina*	o	+	+
Bullfinch	*Pyrrhula pyrrhula*	+	+	+
Yellowhammer	*Emberiza citrinella*	o	o	+
Reed bunting	*Emberiza schoeniclus*	o	o	+

FOOTNOTES

The above order of species is presented according to the standard British Trust for Ornithology checklist. In 1894 the 'Common bunting *Emberiza miliaria'* (now known as Corn bunting *Miliaria calandra)* was recorded. Tree pipit, Tawny owl, Barn owl & Skylark were reported as 'not recently'. Pheasant and Partridge were noted as being 'occasionally', and in 1901 said to be 'not for 12 years'.

KEY

a: 1966-85 data from R.Hastie, F.G.Rodway, E.McKay and the late Russell McMillan (personal communication).

b: 1894-1901 data from D.McLellan (1894) *Glasgow Public Parks* (Smith, Glasgow) and C.Sherry (1901) *The Glasgow Botanic Gardens* (Bryce, Glasgow).

* Collared dove first reported in Gardens in 1974 (immigrant species spread from Asia).

** Unconfirmed report in 1993; seen & heard in the Gardens & Hyndland in 1997 after the survey period.

RESIDENT WILDLIFE, SEEN AND UNSEEN: MAMMALS

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The commonest mammals, by far in the Glasgow Botanic Gardens are humans. On average, about 450,000 people visit the gardens each year. It is therefore surprising, considering its relatively small size, what a variety of other mammals can be found within the gardens.

Most are quite secretive and are seen only occasionally. The main exception is the Grey Squirrel, a native of North America, introduced to central Scotland between 1892 and 1920 and now very well established throughout most of the Glasgow area. There are good numbers of these squirrels in the gardens. They are relatively tame and commonly feed on the remains of food discarded by visitors. Some visitors even bring peanuts and other tit-bits especially to attract them and some squirrels will take these delicacies directly from people's hands. When food is plentiful, many of the peanuts are hidden by the squirrels, often buried just under the surface of the lawns and flower beds. Some are dug up again later, but many will remain where they have been buried. The squirrel's natural food consists of seeds and other plant material, of which there is plenty within the gardens. The squirrels sometimes make use of hollow tree trunks as dens, so beware of putting your arm into one - squirrels have sharp teeth!

Brown Rats are sometimes to be seen, especially near the River Kelvin. These rats are another alien mammal, introduced to Britain, probably from Russia, in the 18th century. Their burrows can be seen in places around the banks of the river. They are also to be found in the old railway tunnel. There is not much evidence of mice. Wood Mice are probably to be found in many parts of the gardens.

House Mice may be present around the glasshouses and other buildings. Voles are often seen by the gardeners in the Kibble Palace. No trapping has been done to establish which species is present, but it possible that both Field Vole and Bank Vole are present within the gardens. No shrews have been recorded, but they too, may well occur. The presence of resident Tawny Owls in the Gardens, suggests that there are enough of these kinds of small mammal for them to feed on. Hedgehogs are occasional visitors. One was seen in 1997. As they feed on slugs, they should be welcomed in any garden. One mammal which the gardening staff are very pleased not to have, however, is the Mole which would not be popular in the ornamental areas.

Evening visitors to the Gardens may be lucky enough to see bats flying along above the paths and close to trees. They are most likely to be Pipistrelle bats (Plate 2), our commonest species. They emerge from their daytime roosts at dusk to feed on small insects which are flying at that time. They may return to their roosts during the night, but will usually re-emerge before dawn to feed again. A single Pipistrelle may consume as many as 3000 midges in a single night. It is suspected that a roost may be present somewhere within the Gardens, possibly in the old railway tunnel, but it has not been located yet. Bats are notorious for changing their roosts at any time. It is probable that most of the bats seen in the Gardens spend the daytime in roosts in houses nearby and move into the Gardens at night to feed. If you stand beside the river at dusk, you may see Pipistrelles patrolling up and down the banks and even flying through the pedestrian tunnel under Queen Margaret Drive. It is worth watching just above the surface of the river, where you may see another species of bat, Daubenton's Bat. It characteristically flies about a metre above the water surface, catching aquatic insects such as caddis flies which have just emerged.

Evening visitors may also catch a glimpse of a fox. Foxes are very regular visitors and may be seen most nights. They are now a common sight in many parts of Glasgow, as they often scavenge from dustbins. Members of the mustelid family are rarely seen. An Otter frequented the River Kelvin running through the Gardens for a week in March 1878. It was later found dead after being caught in a rabbit trap. This event is recorded in the *Proceedings of the Glasgow Natural History Society* for that year by J. Young and the specimen was subsequently stuffed and donated to the Hunterian Museum & Art Gallery, University of Glasgow. More recently, otters have been seen lower down the same river in Kelvingrove Park (1992) and beside the Museum of Transport (1995 and 1997). It is quite likely that they pass through the Gardens along the river without being seen. There is a single record of a stoat, seen crossing Garrioch Road in April 1995. It is highly probably that this animal had come out of the Gardens, where it could have been feeding on rabbits, mice or voles. American Mink, another alien species which escaped from fur farms and now well established in Britain, have been observed along the River Kelvin. They occasionally visit the Gardens and one was seen on the riverbank in the summer of 1997. They will rob birds' nests for their eggs and kill any ground nesting birds as well as eating any fish they are able to catch.

Rabbits used to be fairly common especially around the Arboretum. However, very few have been seen within the last three years. Roe Deer have been observed on a couple of occasions after closing time around the Kirklee end and in the Arboretum, when there are no visitors around to disturb them. They probably gain access to the Botanic Gardens by following the river corridor from the northern edge of the city.

Dogs and cats frequently visit the gardens. There is a resident feral cat which lives in the glasshouses and is fed by the staff. She had several litters of kittens before being neutered. Domestic cats undoubtedly catch some of the small mammals and birds which reside in the gardens. A complete list of the (non-human) species found in the Gardens is given in Table 1.

FURTHER READING

Young, J. (1878). *Proceedings of the Glasgow Natural History Society* **3**, 327-328.

Table 1. List of mammals recorded in Glasgow Botanic gardens.

Common Name	Scientific Name	Status
Hedgehog	*Erinaceus europaeus*	Occasional visitor
Pipistrelle Bat	*Pipistrellus pipistrellus*	Resident? /Frequent visitor
Daubenton's Bat	*Myotis daubentoni*	Occasional visitor?
Rabbit	*Oryctolagus cuniculus*	Formerly common
Grey Squirrel	*Sciurus carolinensis*	Resident
Bank Vole	*Clethrionomys glareolus*	Resident?
Field Vole	*Microtus agrestis*	Resident?
Wood Mouse	*Apodemus sylvaticus*	Resident?
House Mouse	*Mus domesticus*	Resident?
Brown Rat	*Rattus norvegicus*	Resident
Fox	*Vulpes vulpes*	Regular visitor
Stoat	*Mustela erminea*	Resident ?
American Mink	*Mustela vison*	Occasional visitor
Otter	*Lutra lutra*	Occasional visitor
Roe Deer	*Capreolus capreolus*	Occasional visitor
Domestic Cats	*Felis catus*	Resident / Frequent visitor
Domestic Dogs	*Canis domesticus*	Frequent visitor

UNDERNEATH IT ALL: THE GEOLOGY OF THE BOTANIC GARDENS AREA

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It is sometimes possible to see how the rocks, and other geological deposits under the ground, have had an effect on the shape of the landscape. Similarly, the chemistry of the soil and hence the suitability of it for growing certain kinds of plants are closely linked to events in the earth's history long before human beings started to create gardens. Hence an account of the geology is of direct interest and also of general historic relevance to the local area.

The geology of the Botanic Gardens is made up of relatively young surface deposits, including boulder clay, and much older rocks of the Limestone Coal Group (Possil Subgroup) from within the Carboniferous Period. The Gardens were established on what had formerly been farmland. The two local farms were Kirklee and Horselethill. The former was a tiny farm associated with bleaching and the latter a dairy farm. The heavy soil was poor for arable purposes and perhaps the establishment of the Botanic Gardens in this area is surprising, as is the promotion of Kirklee as a nursery garden in 1842. However, this has to been seen in a wider context and can be explained by the radical change in land use during the growth of the city in general and the development of the west end of Glasgow in particular. This arose partly from the desire for middle class housing away from the more polluted city centre to the cleaner air to be found in the direction of the prevailing winds blowing up the Clyde.

The soil brought both problems and opportunities. When the surface materials were stripped off, preparatory to the construction of glass houses, good brick clays were revealed. These had been used locally near Horselethill for brick-making and so a kiln was established on the site to produce bricks for building the walls thus saving the cost of importing them. Other natural resources appear to have been used to save costs of construction such as timber from trees along the river bank. This albeit short-lived timber industry may explain why the riverside pathways were not at first developed. It is likely that use was made of stone from the regular sales of old building materials which were common in Glasgow at the time. The presence of dressed stone and other masonry evidence in the wall at the top of the path leading down to the footbridge over the River Kelvin hint at this. Scavenging for materials is a part of gardening and the presence of much calcined flint in the Gardens came from the old flint mill below Doune Crescent. A mill stone used in constructing the 1993 sundial in the herb garden is a modern example of imported materials which have changed or added to the geological features of the Gardens.

Coal mining took place under parts of the Botanic Gardens down to a depth of 20 metres. The ground structure was typically soil and boulder clay underneath which the rock was composed of a multi-layered sandwich of mudstones, siltstones, sandstones, occasionally interspersed with claybands, and coal. The boulder clay was so heavy that subsurface tunnelling was possible with little or no support. Maps and bore hole descriptions give an idea of the actual sequence of solid rocks underneath the Gardens. First was found a massive sandstone that was fine to medium grained and of an off-white colour with orange staining and ripple layers. Mudstones encountered were generally dark in colour, containing carbon, pyrites and pieces of *Lingula* fossils. The upper mudstone included Jubilee coal that was bright and rusty in appearance. Below this was a grey siltstone progressing to another sandstone containing fossil rootlets, heavy rusty staining and silty ripple layers. Then another mudstone which was slaty and included quartz, mica and more *Lingula* fossil remains. The Knightswood Gas Coal was encountered which was a candle coal of economic importance, yielding after distillation a gas suitable for lighting. It was of drab appearance and was wrought widely from under the western district of Glasgow. Below this seam was more grey siltstone running into fine-grained sandstone to a considerable depth.

The mining methods used locally were typical of the pattern of work required when operating about rockhead but little evidence remains to be seen today in the area. The orange staining seen around various seepages from aquiferous sandstone in the sloping banks of the River Kelvin indicate the iron-rich mineral seams from which the water springs. The bright colour of these seepages is caused by minute bacteria which are able to thrive under such conditions, turning the dissolved iron into rust.

The Kelvin Valley with its steep sides gives some idea of the local geology, with its eroded blocks of sandstone exposed in places. The flood waters of 1994 caused localised damage to the banking and these rock falls show there is a constant process of erosion in the area. As a consequence of this, man-made ground exists extensively along the west side of the Kelvin near the Gardens associated with railway building, bridge construction and housing development.

In the Gardens the most obvious visual element of the geology is the drumlin of flag-pole hill. One of the most noticeable glacial features in Glasgow as a whole is the great number of drumlins, small hills shaped by the movement of ice of 10,000 years ago. The depth of the old railway cutting gives some idea of the thickness of the boulder clay on top of the sandstone and coals below. The ripple markings typical of Carboniferous stone can be seen in the local sandstone used in the Gardens for edging work. However, the appearance of the Gardens now reflects more the energies of the generations of gardeners and the many alterations during the development of the site than the original primeval forces of geology that shaped the surface of the ground.

FURTHER READING

Bassett, D.A. (1958). *Geological Excursion Guide to Glasgow and District.* Geological Society of Glasgow, Glasgow.

SHORT NOTES

Compiled by A. McG. STIRLING

HISTORICAL

The Great Auk or Garefowl (*Pinguinus impennis*) in Scotland

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Historical Information

The extinct Great Auk or Garefowl as it was known in northern Europe was a large, flightless seabird related to the Razorbill which ranged across the northern hemisphere. Due probably to increasing predation by man, the bird abandoned pre-historic mainland breeding sites on both sides of the Atlantic and latterly bred only on off-shore, remote islands. As mariners ventured further into the oceans these breeding stations became accessible and were increasingly raided. At Funk Island near the Newfoundland fishing banks, the flightless Garefowl were easily slaughtered in huge numbers to provision boats crossing the Atlantic. The bird was never as numerous on the Atlantic coast of Europe as it was on the American coastline. It occurred in strong colonies around west Iceland and it continued to survive there in ever decreasing numbers up to the beginning of the nineteenth century. A well documented breeding colony of the Garefowl was situated on a skerry called Geirfuglasker (Garefowl Skerry) off the south-west coast of Iceland. During the eighteenth century this colony was regularly raided and the number of birds fell dramatically. Around Scotland the Garefowl was much less frequently reported and by the late 1700's sightings were extremely rare. It has been recorded from St Kilda, the Faroe Islands and the Orkney Islands. Only two Scottish taken Garefowl are documented and no Scottish taken eggs are known to exist.

The rarity of the Garefowl meant that few of the emerging academically trained naturalists ever saw the bird in the wild and were therefore unable to draw accurately (fig. 1) or record the habits of this species in any detail. Pennant (1784) writes that the Garefowl "feeds much on Lump-fish, (*Cyclopterus lumpus*) and Father Lasher, (*Cottus scorpius*) and other fish of that size". The remarkable speed and agility of the bird underwater is mentioned frequently and Shaw (1819) states that "-they dive and swim under water with the greatest rapidity, for which their short wings are easily calculated, as they perform the office of fins.-"

The Garefowl on St Kilda

One of the most interesting early Scottish reports is given by Martin (1698), writing about his voyage to St Kilda in 1697 in which he describes the Garefowl in considerable detail. He adds that the the bird has "-the hatching-spot upon its breast, i.e., a bare spot, from which the feathers have fallen off with the heat in hatching, -". This description strongly suggests that the Garefowl nested in the area but Martin does not identify a specific locality. Almost one hundred years later the Rev. Buchanan (1793), writes of the Garefowl:- "It appears in July, and even then but rarely, for it does not visit St Kilda yearly". Writers of St Kildan social history seldom mention the Garefowl as a source of food and this implies that the bird was never plentiful. The last sighting on St Kilda was in 1821 when two young men and two boys captured a bird alive. This Garefowl was collected by Prof. Fleming of New College, Edinburgh when he later arrived in the yacht of the Commissioners of the Northern Lighthouses. The bird escaped when the yacht entered the Firth of Clyde and there appears to be some evidence that this bird died soon after and its body cast ashore at Gourock (Grieve 1885).

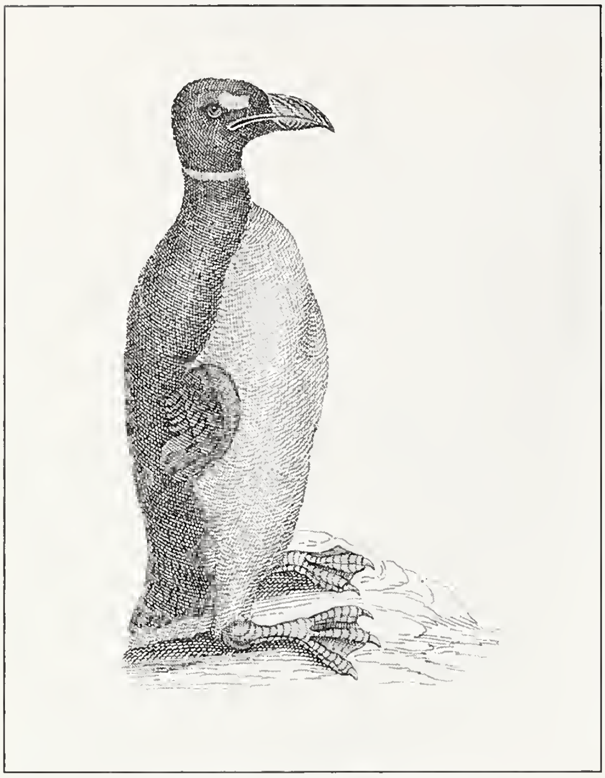
The Garefowl in Orkney

The Garefowl has seldom been recorded on the Orkney Islands and little accurate information exists. The Rev. Low (1813), an Orkney parish minister, made extensive enquiries about the local status of the bird during the 1780's. He reported no recent sightings within living memory. However, a most detailed account is given by Col. George Montagu in which he relates the attempted capture of a Garefowl near Papa Westray in 1813 by a Mr Bullock who pursued the bird in a six-oared boat for many hours - unsuccessfully! (Montagu, 1813). The unfortunate bird was later shot by an islander, William Fowlis, who sent the skin to Mr Bullock for his museum in London (Buckley and Harvie-Brown, 1891). This skin is now in the British Museum of Natural History, London and is one of only two British examples. There is no documentary evidence to prove that the birds ever bred on the Orkneys during recorded history but recent archaeological excavations of Neolithic farmhouse kitchen 'middens' at the Knapp of Howar on Papa Westray have produced skeletal remains of both adult and young Garefowl which suggests that these birds once bred around the islands in pre-historic times (Richie *et al.* 1984). Garefowl remains have also been found in Neolithic middens at other Scotish localities such as Oronsay near Colonsay (Grieve, 1885).

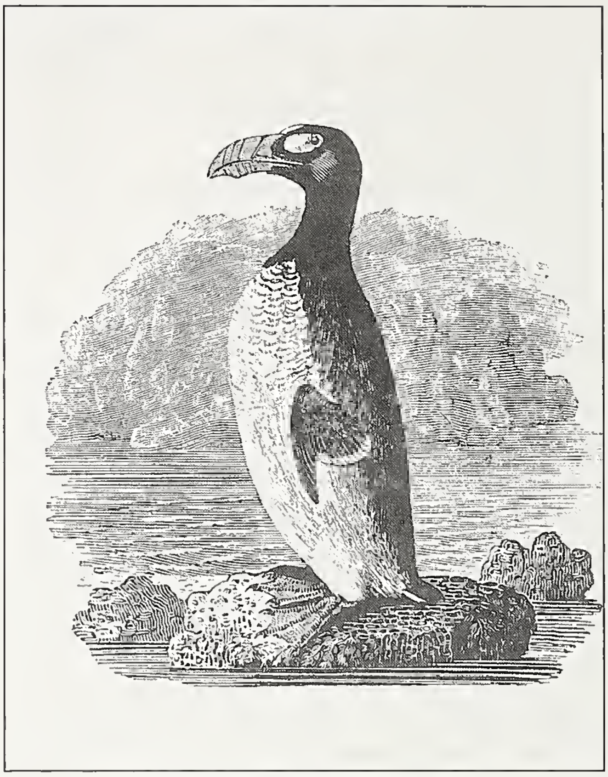
In common with other Auks, the Garefowl spent much of the year at sea and only came ashore to rest and to breed at suitable locations. The flightless nature of the bird dictated that an ideal site would have consisted of flat slabs of rock onto which the birds could easily land in all weathers and tidal conditions. The rocks should rise from the shoreline in a gradual incline so permitting the birds to nest above the high water mark. Only one such place fulfils all these requirements on the Orkney Islands and this is on the west side of a small, seldom visited island called the Holm of Papa Westray (Newton, 1895).

The illustration on the **Front Cover** shows the birds placed into this specific habitat on the Holm of Papa Westray. Separate photographs were combined to produce the computer-generated montage or composite. Dr. B. Zonfrillo provided the background habitat picture of the Holm of Papa Westray and Kelvingrove Museum kindly gave permission to use their photograph of the Garefowl specimen presently on display in the Natural History Gallery. The bird calling was created by repositioning the head and lower mandible of the beak. The tongue was painted in.

Illustrations of the Garefowl in Historical Literature



Copperplate envgraving printed in
'Ornithologia' 1676
by Francis Willughby



Woodcut engraving printed in
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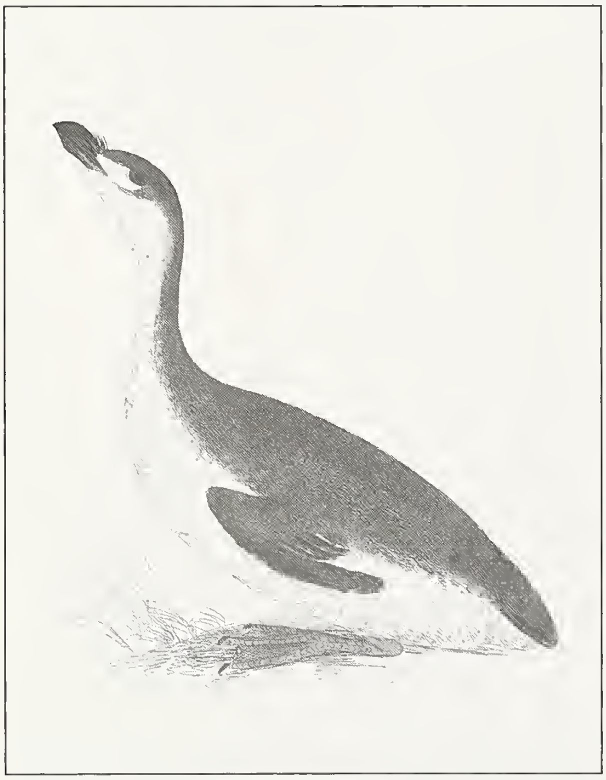

Etching printed in
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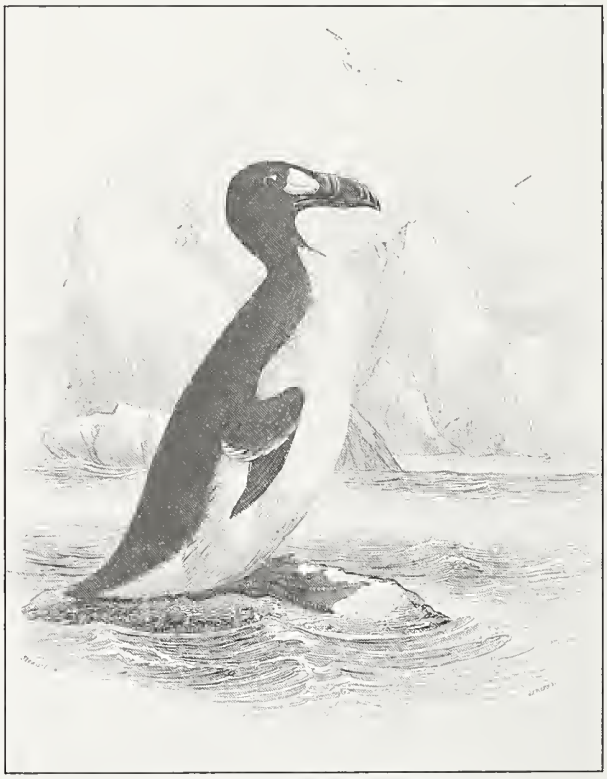
by William Lewin



Steelplate engraving printed in
'The Nat. Hist. of Birds of Gr. Britain' 1843
by Sir William Jardine

Very few of the 17th,18th and 19th century naturalists publishing accounts of British Birds had ever seen a living Garefowl. Artists had to make the illustrations from museum specimens many of which were badly mounted. Some of these birds were in immature or winter plumage which would account for the variations in shape and patterning in the above examples.

Figure 1

The Demise of the Species

At the beginning of the nineteenth century the Garefowl had disappeared from many of its former breeding sites. The aforementioned Geirfuglasker in south-west Iceland became the last remaining colony. In 1830, volcanic disturbances caused Geirfuglasker to submerge and the scattered remnants of the colony took refuge on a nearby but more accessible island called Eldey (Fire Island) situated twenty-five miles south-west of the Reykjanes peninsula on mainland Iceland. During the next fourteen years the few remaining Garefowls at Eldey were regularly slaughtered, no longer for food, but to supply an increasing demand for skins and eggs by European collectors.

The following details of the final demise of the Garefowl is based on an account in Grieve's (1885) monograph on the species. At the beginning of June, 1844 a fourteen man expedition led by Vilhjálmur Hákonarsson set out for Eldey to search for any Garefowl which might be present. At the surf-lashed skerry only three men managed to climb ashore at considerable risk. They were Sigurör Islefsson, Ketil Ketilson and Jón Brandsson. As the men clambered up they saw two Garefowl sitting among numerous other seabirds and quickly gave chase. Brandsson, with outstretched arms, drove one into a corner where it was killed. Ketilson and Islefsson pursued the other which was eventually seized close to the edge of a rock at the water's edge. A broken Garefowl egg was found near where the birds were first seen.

Little did these men know, or care, that they had killed the last of the Garefowl. From that date onwards no living Garefowl has ever been seen or heard.

Mankind destroyed the Garefowl but modern technology has now made it possible to return the bird to its natural habitat - sadly, only as an image!

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The Legacy of the Loch Lomondside Wolf - Additional Notes

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The following notes supplement an earlier paper on the Loch Lomondside Wolf (Mitchell, 1996).

Following the dissolution of Central Region on 31 March 1996, the new administrative body - Stirling Council, which takes in west Loch Lomondside - re-adopted the famous Stirling wolf in the design of its coat of arms. It is rather disappointing however, that the animal as represented resembles Sir Arthur Conan Doyle's 'Hound of the Baskervilles' more than an actual wolf. Continuing on the heraldic theme, one Loch Lomondside wolf connection that I had overlooked was the Lumsden of Arden coat of arms, in which wolves' heads feature in the first and second quarters of the shield (Fig. 1). The wolf association with the Lumsdens dates back to the 13th century, reputedly originating from the name of 'Old Wolf' linked to the family of Aldecambus who lived at Lumsdaine in Berwickshire. The Aldecambus family subsequently adopted the name Lumsden after their estate, the wolves' heads appearing on their coat of arms for the first time in the mid 16th century (A. Lumsden *pers. comm.*).

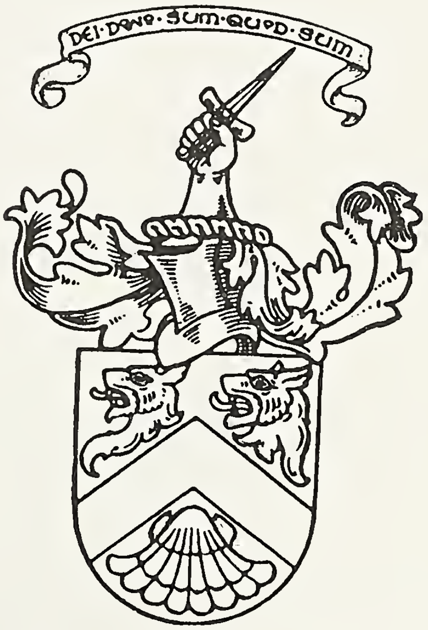

Figure 1. The Lumsden of Arden coat of arms

What appears to be the hitherto missing piece of the story relating to the 'Watchmeal of Kilpatrick' has recently come to light in the archives of Dumbarton Library. To recap: the watchmeal, first recorded in the 14th century, was a local tax of meal (later commuted to money) imposed on certain Kilpatrick proprietors, part of what was exacted being used to feed the dogs kept at Dunbarton Castle for the purpose of hunting down wolves. Despite the extirpation of the wolf in Scotland by the mid 18th century, obligation to provide or pay the watchmeal continued into modern times. Amongst the library's local collection is a box containing typescript notes for an unfinished 'History of Dunbartonshire' by William Craig (1849-1934). A lawyer by profession, Craig was appointed to a number of public offices in Dunbartonshire including County Clerk 1896-1921, positions which gave him access to land transfer records. According to his unpublished notes, the feu superiority of the Kilpatrick estates liable for payment of the watchmeal passed out of the hands of the Duke of Montrose to the Edmonstones of Duntreath about the year 1790, before being sold on to William Dunn of Duntocher in 1826.

I am grateful to James A. Lumsden of Bannachra Castle, Glen Fruin, for permission to illustrate the Lumsden of Arden coat of arms. Also to Dumbarton Library Services for making available the Craig papers from the library archives.

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GEOLOGICAL

Millholm cliff fall

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A prominent monolithic sandstone cliff above black shales was a feature of the White Cart about Millholm. The erosion of the black shales and falls of stone into the river was a constant feature of the area. About the 6th March 1997 the rock face gave way, debris smashing down and across the river, throwing materials many metres. Erosion may have been the cause but mechanical plant causing vibration across a fracture line was contributory. The fracture line was roughly on the course of the lower parkland path and site examination on 6th and 8th March showed the line. The weight of fall was many metric tonnes and site security and clearance of debris was rapidly begun.

The incident was of geological interest since, with the exposed face, it was possible to relate the black shales to the location of coal outcrops in the cliff above. It was, though, the case that the dip could not safely be confirmed with the oscillation of the strata. The coals in the area were the Smithy and the Main, the former once being tried from a day level driven in from the line of the parkland pathway and still partly exposed. Below the line of the path, the Main coal occurred and was exposed at the point where the path had been taken away in the rock fall. The Main coal was traceable across the broken cliff as a seat-earth mix in the exposure. The rock debris below the face revealed some fossil tree material, a feature of the Linn of Cart.

The collapse of the east bank at Millholm showed clearly the fragile nature of the area, much of it mined for coal and also limestone. It underlined the need for caution in exploring this old mining area.

I acknowledge Stuart Nisbet for sharing the investigation of the site.

BOTANICAL

Lesser Sea-spurrey

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Lesser Sea-spurrey (*Spergularia marina*) was noted on verges of the A1 in Berwickshire and of the A68 at Carter Bar in the Cheviot Hills in 1992, with enormous spread in the Scottish borders in the ensuing four years (Braithwaite, 1997).

In September 1996 we were alerted to its occurrence as a roadside plant in Lanarkshire (VC 77) by M.E. Braithwaite who had observed plants along the A721 and the A702 while on a Hawick - Glasgow return journey.

In the 15-month period September 1996 - November 1997, 81 x 1km square records have been made of Lesser Sea-spurrey on road verges in Lanarkshire. We have found the plant on approximately half the occasions that we have stopped at likely looking locations.

It is usually found close to the road, either on its own or intermingled with other short herbage. Typical associated species are Annual Meadow-grass (*Poa annua*), Procumbent Pearlwort (*Sagina procumbens*), Pineappleweed (*Matricaria discoidea*) and Knotgrass (*Polygonum aviculare*).

The furthest distance in from the road that the plant has been seen is three yards. At some sites there is just the occasional plant, but in other localities we have found fairly solid colonies up to 100 yards in length.

So far Lesser Sea-spurrey has been found along 14 A roads, 11 B and six unclassified roads. We consider it likely that it is also present along most of the other classified roads in Lanarkshire which we have not yet surveyed. Exceptions are the A71 and B743 south of Strathaven where the plant has been sought at intervals without success. It has however, been seen on the verge of the A71 between Strathaven and Stonehouse.

Just north of the M8, near Kirk of Shotts, there is a road department depot. On the side of the entrance from the public road there is a solid carpet of *S. marina* approximately 100 yards in length and one yard wide.

The occurrence is obviously the result of the sand/salting of the roads in winter, the salt giving the sea-spurrey the required salinity and also discouraging the growth of other road-side plants.

Reference

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Mossy Sandwort at the Falls of Clyde

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In September 1996 we discovered a mat of Mossy Sandwort (*Arenaria balearica*) growing on a vertical rock face just down stream from the Bonnington Linn dam at the Falls of Clyde, Lanarkshire (VC 77). On a return visit in 1997 the plant was noted to be flowering profusely and a voucher specimen was taken (herbarium PM). This is the first record of the sandwort from the wild in the vice-county.

As indicated by the Latin name, *Arenaria balearica* is endemic to the western Mediterranean but is commonly grown on walls and in rock gardens in this country. It is one of the smallest, if not the smallest, plants sold by nurserymen.

Corner (1996) stated that the plant was rarely to be found at any distance from gardens but reported on established colonies due to water-borne spread in Perthshire. Some of his scattered colonies were on stonework, others on flat sandstone rocks at the edge of the river where they would be covered by higher than average floods and also on damp vertical cliffs ascending to 4.5m above the mean river level.

The Falls of Clyde site must also be the result of water-borne spread and like those in Perthshire has a generally north-facing aspect which would help to prevent the plant being dried out. It is unlikely that the colony has been present for more than a few years, otherwise it would have been noted earlier in this well botanised area.

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Wood Barley in Fiddler's Gill

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In 1995 I obtained from Scottish Natural Heritage a copy of a plant species list compiled by 'RAP' during a survey of Fiddler's Gill in 1987 (26/6.4). This is a wooded gorge, through which flows the Fiddler Burn, lying to the north east of the River Clyde valley, Lanarkshire (VC 77). The list included *Hordelymus europaeus* (Wood Barley). Stace (1991) states that this plant is local in Britain, north to South Northumberland (VC 67) and formerly was found also in County Antrim (VC H39) and Berwickshire (VC 81). In the *Atlas of the British Flora* (Perring and Walters, 1962), the only record for Scotland is a pre-1930 dot - evidently referring to an 1885 record from Pease Dean, VC 81 (NT 79-70-). Braithwaite and Long (1990) consider the grass now extinct in this locality. My scepticism of 'RAP's' report was therefore understandable and I did not include it in the Lanarkshire records.

I had no thought of the grass in 1996 when going to check on Herb Paris (*Paris quadrifolia*), the Gill's most notable plant. I was stopped in my tracks at the sight of a clump of Wood Barley and immediately recalled to mind the record for *H. europaeus*. I took a specimen (now in herbarium PM) and the identification was confirmed by Dr H.J.M. Bowen.

In August 1997 I returned to survey in detail the distribution of the plant and record its associates. Wood Barley was found in only one area, approximately 10 yards in diameter. Twenty plants were counted, the largest having nine flowering spikes and the tallest just over four feet. The plants grow under a canopy of Ash (*Fraxinus excelsior*) and Hazel (*Corylus avellana*). The close associates noted were bramble (*Rubus* sp.), Wild Strawberry (*Fragaria vesca*), Wood Avens (*Geum urbanum*); Great Wood-rush (*Luzula sylvatica*); Scaly Male-fern (*Dryopteris affinis* sl), Lady-fern (*Athyrium filix-femina*); Wood Melick (*Melica uniflora*) and False Brome (*Brachypodium sylvaticum*). Other grasses in the vicinity were Wood Meadow-grass (*Poa nemoralis*), Tufted Hair-grass (*Deschampsia cespitosa*) and Wood Brome (*Bromopsis ramosa*).

It would appear that Fiddler's Gill is the only site in Scotland for Wood Barley making the discovery a very important record. Consideration must therefore be given to the status of the plant. In addition to the above noted associates, in the vicinity there are two clumps of Pendulous Sedge (*Carex pendula*). The question arises as to whether the sedge is native or alien, and if introduced, could the Wood Barley also be an introduction, either intentionally or accidentally with the sedge. I know of no occurrence where the grass has been introduced intentionally. Pendulous Sedge is regarded as being native in rich heavy soils in woods, with scattered records in Scotland but is known to be grown for ornamental purposes (Stace, 1991). The habitat matches the description of that occupied by native plants and there is nothing to suggest that the occurrence of the sedge at Fiddler's Gill should not be included with the other scattered Scottish native sites.

The Gill is rich botanically, having at least three scattered colonies of Herb Paris and it seems reasonable to regard Wood Barley as having native status there.

I have now ascertained that the 'RAP' referred to above is Richard Pennington to whom goes the credit for making the first record of *H. europaeus* in Fiddler's Gill.

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Old Cornstone Workings - A Supplement

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Since the publication of an earlier paper on Old Cornstone Workings (Mitchell, 1995), sufficient additional information has become available to warrant a short supplement.

Traditionally, the cornstone bearing sandstones in Central Scotland have been placed entirely in the Upper Old Red Sandstone. These have now been assigned to the Inverclyde Group, the basal layer of the group containing the lime rich cornstones - the Kinnesswood Formation - forming a transitional zone between the late Devonian and early Carboniferous rocks in the region (Paterson & Hall, 1986; Stephenson & Gould, 1995).

The following amendments should be made to the list of selected sites given for the less common plants of cornstone influenced grassland, flushes and mires (Table 2 in Mitchell, 1995) :-

Sagina nodosa	Add site 2, Kipperoch
Gentianella campestris	Add site 8, Wester Balgair (C. Prentice)
Dactylorhiza incarnata subsp. *pulchella*	Add site 2, Kipperoch

Note: to the previous entries for *Dactylorhiza incarnata* add subsp. *incarnata*.

Further exploration in the Dunbartonshire portion of the Kilpatrick Hills over the last two years has resulted in yet more cornstone workings being found. Of these, the most botanically interesting are situated alongside the headwaters of the Gallangad Burn:- Spouts Burn (NS 445796) and Knockupple Burn (NS 455791). Noteworthy species present include *Galium boreale* (Northern Bedstraw) and *Melica nutans* (Mountain Melick), both previously unrecorded at identified cornstone sites elsewhere within the study area.

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ZOOLOGICAL

The Black-Headed Ribbon Worm (Nemertea: Tetrastemmatidae) in the Clyde Sea Area

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The nemerteans of the Clyde Sea Area were first reviewed by Stephenson (1911) who recognised 12 species in the vicinity of the Marine Station at Millport. Over seventy years later, Gibson (1982) published the first synopsis of British nemerteans, including distribution records of all known species. The tally of species from the Firth of Clyde had by then reached 26. Published records of nemerteans are relatively scarce (see Gibson, 1988). For example, *Amphiporus elongatus* described as a new species to science by Stephenson (1911) based on a single specimen from Fairlie Sands, was not recorded again until the redescription by Gibson (1989) from new material collected in Kames Bay, Millport.

The Clyde River Purification Board in its environmental surveys of marine and estuarine sediments over a twenty year period frequently recorded nemerteans. However, the need to fix samples with formalin prior to examination usually precluded precise identification. There were, however, some notable exceptions. For example, *Tubulanus polymorphus* Renier, 1804, develops a distinctively demarcated colour pattern in the anterior region following preservation, making it easily recognisable even in fixed samples. It appears to be widely distributed and quite abundant (several hundred per square metre) in sublittoral sediments between Greenock and Irvine Bay. The bizarre nemertean, *Malacobdella grossa* (Muller, 1776), an endoparasite of molluscs (especially the bivalve *Arctica islandica*) is readily identified within its host. It has been recovered inadvertently from damaged *Arctica* by the CRPB on two occasions; at Whiting Bank (3km east of Garroch Head) in 1970, and in Irvine Bay (1km off Stevenston) in 1981. On both occasions it was initially misidentified as a leech which it superficially resembles!

In May 1997, during a routine intertidal survey of the Garnock Estuary by the Scottish Environment Protection Agency, a greenish ribbon worm, about 6.5cm long, was noticed in overturned sediment (just south of McGowan's Bridge). The worm was returned alive to the laboratory where it was identified as *Tetrastemma melanocephalum* (Johnston, 1837). The head pigmentation pattern resembled that figured by Gibson (1982, Fig. 44A) and the colouration was similar to the illustration of Brunberg (1964, Plate 4, Fig. 1). All colouration and pigmentation faded shortly after fixation of the specimen. According to Gibson (1982, Fig. 46D) *T. melanocephalum* is widespread in Britain but has not yet been recorded on the west coast of Scotland. Its occurrence in the Garnock Estuary is not entirely unexpected - it is known to tolerate lowered salinities of estuaries and *Corophium* shrimps, one of its favoured prey, are abundant at this locality. It may seem surprising that it has gone unobserved before in an area that has been frequently surveyed. However its greenish colouration renders it easily mistaken for one of the small ragworms (*Hediste diversicolor*) which are especially numerous here.

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Pill Woodlouse *Armadillidium vulgare* in Clydebank

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The Pill Woodlouse, *Armadillidium vulgare* preferring a calcareous soil has a rather local distribution in the West of Scotland (G. Hancock, pers. comm.; see also Stirling, 1995; Corbet, 1997; Hancock, 1992).

During the past few summers (1995, 96 & 97) I have seen many Pill Woodlice among garden debris and leaf litter at two locations in Clydebank. The first site, at Parkhall Road, Clydebank (NS 488 718), is a suburban garden where several specimens were seen. The second, the grounds surrounding the Clydebank Burgh Band Hall, Second Avenue, Clydebank (NS 495 710). This latter area is overgrown and largely undisturbed and here, greater numbers, (approx. 30 individuals on one occasion) were seen.

Thanks to Geoff Hancock who verified the identification of the specimen.

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Stirling, A.McG. (1995). Pill Woodlice records from south-west Scotland. *Glasgow Naturalist* 22, 528-529.

The Status of the Highland/Common Darter *Sympetrum nigrescens/striolatum* in Dunbartonshire (VC 99)

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Referring to the recently published Atlas of Dragonflies of Britain and Ireland (Merritt *et al.*, 1996) we note that *Sympetrum nigrescens/striolatum* has not been recorded in the vice county of Dunbartonshire.

From the examination of several water bodies in Dunbartonshire for Odonata during 1997 we encountered many individuals of *Sympetrum nigrescens/striolatum* suggesting it is a widespread resident. A summary of observations is presented in Table 1. At Dumfin Quarry and at Dalreoch Forge pond we observed freshly emerged adults indicating the darters had been present in 1996 as breeding residents. We also observed ovipositing behaviour in 1997 at these two sites.

The distinction between the Common Darter *Sympetrum striolatum* and the Highland Darter *Sympetrum nigrescens* as different species is in doubt (Brooks & Lewington, 1997; Hammond, 1983; Merritt & Vick, 1983; Merritt *et al.*, 1996) and they may be races of the same species.

The darters observed in Dunbartonshire included individuals of the Highland Darter coloration (see Hammond, 1983; Miller, 1995; Brooks & Lewington, 1997). Indeed all the individuals captured and examined in the hand (11 adults) had thorax patterns of the *nigrescens* form (see Miller, 1995). However, the black facial markings, used as a feature to separate *nigrescens* and *striolatum*, were variable in the individuals examined with some showing the *nigrescens* type pattern and others showing the *striolatum* type pattern. This could indicate that black facial markings are variable within the *nigrescens* form or that Dunbartonshire represents a zone in which intermediates between *nigrescens* and *striolatum* are found.

Thanks to John Mitchell for comments on the manuscript.

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Table 1: Observations of the Highland/Common Darter in Dunbartonshire (VC 99) during 1997.

Water Body	Grid reference	Date of observation	Numbers
[1] Dumfin Quarry Pond, Helensburgh	NS 337846	19/7/97 & 13/8/97	7 10
[2] Dalreoch Forge Pond, Dumbarton	NS 391760	25/8/97 & 9/9/97	7 9
[3] Ben Bowie Forest track, Helensburgh	NS 330837	24/8/97	2
[4] Drumkinnon Pond, Balloch	NS 385822	25/8/97	1
[5] Leven Industrial Estate Pond, Alexandria	NS 397781	25/8/97	1

[1] Teneral adults observed freshly emerged. Breeding site. All individuals had Highland Darter coloration.

[2] Adult males and females observed. Breeding site. All individuals captured had typical thorax coloration associated with the Highland Darter but some lacked the well defined black facial markings, more typically associated with the Common Darter.

[3] Territorial males observed.

[4] Adult male observed.

[5] Adult male observed.

The successful colonisation of the Brucehill Cliff Local Nature Reserve, Dumbarton, by Orange Tip butterflies *Anthocharis cardamines*

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Over a period of 8 years we have been recording butterflies at the Brucehill Cliff Local Nature Reserve, Dumbarton (NS 382 754) as part of the butterfly recording scheme organised by the Glasgow & South-west Scotland Branch of

Butterfly Conservation.

Due to the current interest in the expansion of the range of Orange Tip Butterflies in Scotland (Sutcliffe, 1991; Sutcliffe & Kirkland, 1998; Thomas & Lewington, 1991) we present data indicating the successful colonisation of a moderately sized (6 hectares) grassland habitat at the Reserve in Dumbarton.

In the years 1990, 1991 and 1992 no Orange Tip butterflies were recorded from visits made to the grassland site during the normal flight period of April, May and June.

The first Orange Tip butterfly was recorded at the site on 8th May 1993. From Figure 1 it can be seen that Orange Tips have been recorded in successive years since 1993 and are now well established at the site. Both eggs and larvae have been recorded and Cuckoo Flower *Cardamine pratensis* seed pods are the main food plant, although female Orange Tip butterflies have also been seen laying eggs on Sea Radish *Raphanus raphanistrum* subsp. *maritimus* seed pods.

Numbers of Orange Tips were recorded from transect walks through the grassland site using the standard method (see Butterfly Monitoring Scheme: Institute of Terrestrial Ecology, 1981). Butterflies were recorded that came within 5 metres in front of the recorder while walking at a standard pace along the same transect route at approximately weekly intervals.

The population of Cuckoo Flower at the site (see Futter 1990, 1992 and 1994 for a site description) is moderate in size and local in distribution but has probably sustained an important reservoir population of Orange Tips allowing further local expansion of its range in Dunbartonshire.

Co-existing with the population of Orange Tip butterflies is a larger population of Green-veined White *Pieris napi* (see Table 1 for butterflies recorded at Brucehill Cliff LNR).

We are grateful to Richard Sutcliffe for encouragement and for providing details of the Butterfly Conservation butterfly recording scheme.

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Table 1: Butterflies recorded at Brucehill Cliff Local Nature Reserve 1990 - 1997.

Species	Abundance	Status
Orange Tip	common	resident, breeding
Green-veined White	common	resident, breeding
Small White	common	resident, breeding
Large White	uncommon	non-breeding
Clouded Yellow	rare visitor (1992)	non-breeding
Small Copper	uncommon	resident, territorial males, breeding
Common Blue	uncommon	non-resident, occasional territorial males
Small Tortoiseshell	common	resident, breeding
Red Admiral	uncommon	breeding
Painted Lady	uncommon	non-breeding
Dark Green Fritillary rare,	irregular visitor	non-breeding
Meadow Brown	common	resident, breeding
Small Heath	uncommon	resident, breeding
Wall Brown	rare visitor (1990)	non-breeding

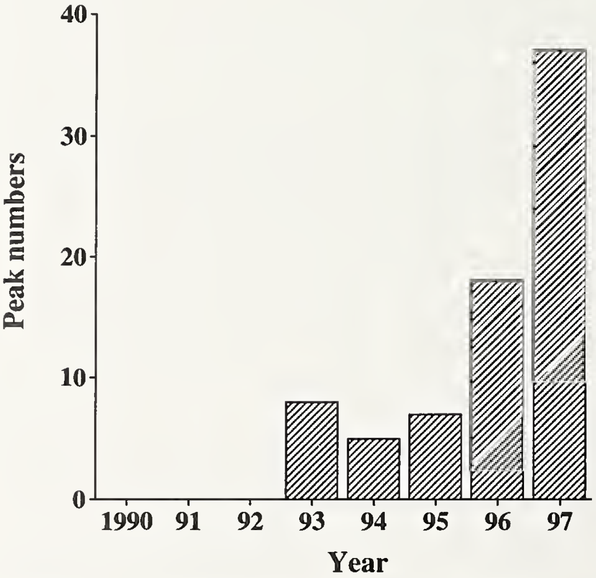

Figure 1: The Peak numbers of Orange Tip butterflies observed from a transect walk during the main flight period, May - June.

The Spread of the Orange Tip in Scotland

Richard Sutcliffe[1] and Paul Kirkland[2]
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The Orange Tip *Anthocharis cardamines*, is one of our most distinctive butterflies. The male is unmistakable; a medium sized white butterfly with orange and black wing tips. The female is less conspicuous, lacking the orange markings. At a distance it can be mistaken for a ‘cabbage white’. In both sexes the underside of the hindwing has a mottled, moss green pattern, looking like lichen against a white background. The butterfly is normally on the wing in Scotland from late April until mid-June.

In the mid-nineteenth century, the Orange tip was found throughout most of Scotland and was considered to be widely distributed and rather common in the Clyde area. By the beginning of this century, however, the butterfly had declined considerably and had disappeared entirely from many areas. In 1980 it was confined to the Borders and the Grampian - Strathspey areas. Since the early 1980s it has returned and is re-colonising many of its old haunts.

In 1997 Butterfly Conservation organised a popular survey in Scotland using postcards featuring a colour photograph of a male Orange Tip on one side and space for recording on the other. The main aims of the survey were to promote an awareness of butterflies (and other insects) in gardens, to promote butterfly recording and to provide data about the rate of spread of the Orange Tip in Scotland.

The Orange Tip was on the wing exceptionally early (about three to four weeks earlier than normal). It was first seen on 28 March at Kinfauns, Perth (the earliest date on record for an Orange Tip in Scotland). The last reported sighting of an adult was on 26 June at Dumfries, making a flight period of 90 days.

New areas appear to have been colonised. The most notable records came from Scourie, Raasay, Skye, Bute and Arran in the west and several records from the Borders in the east, but there were also many other new records throughout the butterfly's range. See Figure 1, and Futter and Futter (1998).

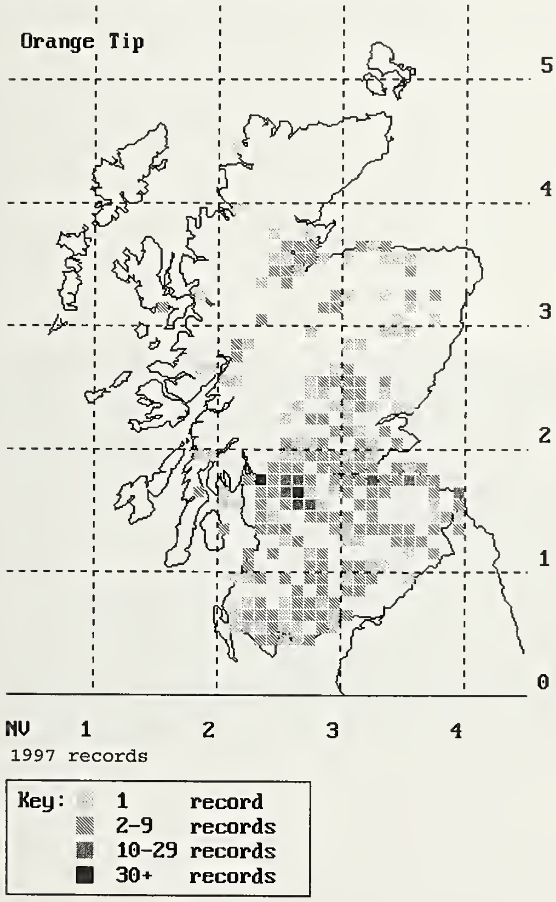

Figure 1. All records of Orange Tips in Scotland 1997.

The survey is being run again in 1998. All records of Orange Tips from anywhere in Scotland are needed to build up a complete picture of the butterfly's expansion. Please send any records to Richard Sutcliffe.

The authors are grateful to Butterfly Conservation (Education and Information Committee) and Scottish Natural Heritage for funding the postcards.

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The Crystal Goby as a host to Caligid Copepod larvae

Myles O'Reilly

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The former Forth River Purification Board undertook routine monitoring of benthic fish populations at various localities in the Forth Estuary and Firth of Forth for the purpose of pollution assessment (Elliott *et al.*, 1988, 1989, 1990). During one of these trawling surveys at the Kingston Hudds grounds (about 7km south of East Largo Bay) in August 1989, a number of Crystal Gobies, *Crystallogobius linearis* (von Duben, 1845), were recovered as an incidental by-catch. A sample of these returned to the laboratory for closer examination revealed the presence of parasitic copepod larvae.

The thirteen parasitised fish ranged in size from 37 to 42 mm and each harboured one to six copepod larvae (mean 2.5). The chalimnus stage larvae were all attached with a frontal thread and were between 0.7 and 0.9 mm long. Most of the copepods were attached in the anterior region: on the pectoral and pelvic fins, on the gill cover, or on the lower jaw. A few attached ventrally to the anal fin.

The larvae were examined in more detail by Dr Geoff Boxshall of the British Museum (NH). The presence of well developed subchelate maxillipeds in all the specimens examined suggested that they probably belonged to the family Caligidae. *Caligus elongatus* Nordmann 1832, one of the commonest parasitic copepods in British waters, is already known to infest nearly forty British fish species (Kabata, 1979) including the Sand Goby, *Pomatoschistus minutus* (Pallas, 1770), (see Boxshall, 1974) and the Two-spotted Goby, *Gobiusculus flavescens* (Fabricius, 1779), (syn. *G. ruthensparri*, see Bossanyi & Bull, 1971). Another caligid, *Pseudocaligus brevipedis* (Bassett-Smith, 1896) has been recorded from the Rock Goby, *Gobius paganellus* Linnaeus, 1758.

It is not known whether the caligid larvae on the Crystal Gobies can attain maturity on the same fish. Certainly up to six adult copepods would prove a heavy burden on such a small fish. It is possible that they might migrate to a larger host species at a later stage. This new record is apparently the first of the Crystal Goby acting as a host to parasitic copepods in UK waters. The material is deposited in the National Museum of Scotland, NMSZ 1997.139.

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A Pink-backed Pelican, *Pelecanus rufescens*, from Kirkcudbrightshire

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On 23rd December 1995 a Mr Murdoch of Ringford, Castle Douglas (grid ref. NX682610) reported to one of us (R.N.C.) that there was a pelican in one of his fields. Although this identification seemed unlikely on zoogeographical grounds, the bird was brought to the Galloway Wildlife Refuge by Mr W. Gilchrist, the local SSPCA officer. This allowed confirmation of its identity as a pelican, most probably a juvenile White, *Pelecanus onocrotalus* or Dalmatian, *P. crispus*, on the basis of its greyish-brown plumage and small body size. The bird was very weak, dehydrated and emaciated, so attempts were made to rehydrate it, but unfortunately, it died overnight.

The bird was sent to the Royal Museum of Scotland where it was identified as an adult female Pink-backed Pelican, *P. rufescens*, in non-breeding plumage. The stomach was blocked by a large fish hook and fishing line, making it impossible for the bird to swallow food. The pelican was prepared as a study skin (register no. NMSZ 1996.51) (Fig. 1).

There had been several sightings of Pink-backed Pelicans throughout Britain during the previous summer and autumn of 1995, including Kent, Essex, Tyne and Wear and the inner Solway Firth near Annan (4-19 August) (Anon., 1995; Rogers *et al.*, 1996). The most recent sighting had been on 18th December 1995 on Loch Ken, Kirkcudbrightshire and this was almost certainly the same bird that was found at Ringford.

The Pink-backed Pelican is found throughout sub-Saharan Africa, but occurs regularly in southern Egypt to 23°N on the Red Sea, and occasionally as a vagrant in the eastern Mediterranean (Israel) (Cramp & Simmons, 1977; Brown *et al.*, 1982; Hollom *et al.*, 1988). It was unlikely that the pelicans observed in Britain during the second half of 1995 were the result of a dramatic colonisation of Europe on a par with that of the Collared Dove, *Streptopelia decaocto*, during the 1950s (Gibbons *et al.*, 1993). The European Endangered Species Programme office in Amsterdam were finally able to reveal their source (F. Rietkerk, pers. comm.). Several Pink-backed Pelicans were confiscated by Dutch Customs and were sent in May 1995 to Birdpark Avifauna, Alphen, The Netherlands. However, while there they regrew their flight feathers earlier than expected and all left Alphen on 30th June 1995. It is rare that the complete history of an unusual escaped exotic bird is known so well. Bird park Avifauna has apologised for this piece of unintentional avifaunal pollution.

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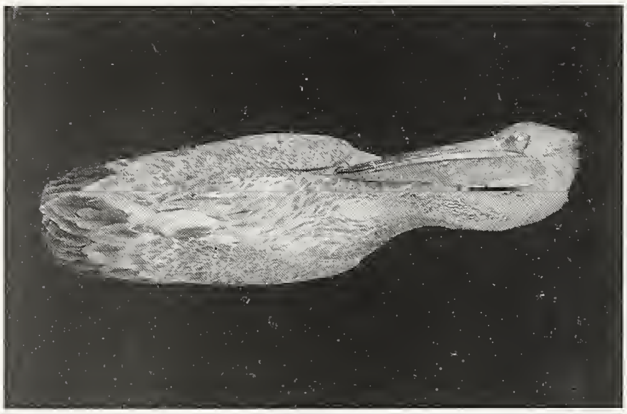

Figure 1. Skin of the Kirkcudbright Pink-backed Pelican.

Tree Creeper and "Witches Brooms" in Kelvingrove

Brian S. Skillen
46 Munro Road, Jordanhill, Glasgow G13 1SF

Tree Creepers are a regular feature of the parkland. Two sightings during 1997 were of interest. On 7th April a pair of birds were watched in ritualistic behaviour about the birch plantings on the hill below the statue of Lord Roberts. One of the birds was demonstrative and on a number of occasions flew to another bird working a nearby tree trunk. The displaying bird presented the other with insects. The insect hunting was done from "Witches Brooms" which were approached in an aerobatic flight and worked for insects by the bird hanging upside down from twiggy growth. The "Witches Brooms" are deformities in birch caused by the buds being attacked either by fungus or insects. The twiggy growths were on inspection found full of insects, hence their attraction to the birds.

On 16th April a single Tree Creeper was watched on trees close to Parkgove Trerrace, working the tree trunks. The bird was persistently attacked by a female Blackbird and mobbed to the point that physical contact was made. The Tree Creeper on being hit fell from the tree and made a low stalling flight off to cover chased by the Blackbird.

Seal on the River Clyde

Brian S. Skillen
46 Munro Road, Jordanhill, Glasgow G13 1SF

On the 6th, 7th and 9th January 1997 sightings were made of a seal in the River Clyde, aptly in the vicinity of "Neptune's Lady" approximately NS 590646. This area of the river is the outlet for a sewer cum stream which may warm the river waters. It is a successful feeding site for Cormorant and both birds and seal were seen feeding in the area. What would appear to have been a common seal was active about the upper stretch of the Clyde up to the suspension bridge for about a week, after which it disappeared.

On the 14th a neighbour found a dead seal washed up at Helensburgh: I was told of this the following day but whether the seal was the same is not clear: certainly, I had no further sightings within the city harbour area.

Compiler's Note

During December 1997 three reports, in the form of 'Letters to the Editor', appeared in *The Herald* regarding observations of seals in the upper Clyde area. The locations were (1) One mile upstream from the Erskine Bridge (December 1997); (2) Between the Renfrew Ferry and the School of Nautical Studies, Seamanship Centre (many sightings 1996-97); (3) Mavisbank Quay (1997).

Hyndland Squirrels - A Gathering

Norman R. Grist
5A Hyndland Court, 6A Sydenham Road, Glasgow G12 9NR

Grey squirrels (*Sciurus carolinensis*) have long been established in Glasgow parks, including Dawsholm and the Botanic Gardens near this address (MR: NS 560.675). During over 40 years living in Lorraine & nearby Sydenham roads, we rarely saw even a passing squirrel until 1987 when four established a winter nest (not used since then) in a tree across the road. Occasional sightings of one to three in the next three years was followed by establishment of a population of three "regulars" plus two occasional visitors, entertaining us by their antics and balanced interactions with local cats. Sometimes a squirrel would flee from a cat, sometimes a squirrel would chase a cat, generally being mutually wary but tolerant. During 1994-96 we continued to familiarise ourselves with their behaviour and raucous protests at cats or other annoyances.

1997 brought some surprises. The stable population in our immediate vicinity now numbered four to five. About 8 a.m. on the chill, grey morning of January 22nd I watched one lone acrobatic squirrel leaping on and off, over, through and round a springy cotoneaster. About 3 p.m. next afternoon, still grey and chilly, there were suddenly 12 or more squirrels racing through trees, along walls, joining in hyperactive chases and interactions on the ground, round tree-trunks, through branches, and circling around planters on the flat garage roof. They made sounds unfamiliar to us - excited "humming" noises, high squeaks on close encounters nose-to-nose or nose-to-tail without actual contact, sexual or otherwise. While watching but not touching a nearby neighbour they would perform ritualistic preening of their own bodies and tails. After about half an hour, numbers dwindled to six, five, finally our usual three to four. Mary Grist, Mr R. Lazzarini and, for the last ten minutes, myself witnessed the episode. Since then our local sightings have numbered from three to five, most more wary of us than before the convention.

This temporary gathering was unique in our experience and that of others to whom we have mentioned it. The handbook by Corbet & Harris (1991) does not describe it, but mentioned population dispersal in spring (yearlings) and summer (spring-borne young), not January, and describes the calls as: buzz, kuk, quaa, moan, squeak, growl, scream, tooth-chatter, lip-smacking, muk-muk and an undescribed 'mating call'. Was our unusual episode a pre-spring communal mating exercise, despite the weather?

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Mink on the Forth & Clyde Canal

Brian S. Skillen
46 Munro Road, Jordanhill, Glasgow G13 1SF

Two good sightings of mink were made on the canal in 1997 showing different behaviour. The first encounter was on 5th January at Hamiltonhill, about NS 582675. I was walking from Port Dundas and noted mink tracks on the frozen surface of the canal, doubling back and forth. The large fluffy black mink which emerged from the side of the canal at the basin at the foot of Hamiltonhill played for several minutes on the ice, skidding on the surface, leaving odd tracks. The animal vanished once it became aware of my presence. The mink was playing close to an active "doo hut" and it was as well that the pigeon fanciers were too intent on their birds to note what was on the canal immediate to them. The mink was a large and probably full grown adult fluffed up in the cold and indulging in a spirited display. The second sighting was on the 20th July about NS 588702, near to Over Possil. The mink had been hunting in the reeds when I disturbed it and put up an aggressive display. The animal went into the canal after standing its ground for a few moments and swam across to the opposite reedy bank and disappeared into cover. The mink re-emerged briefly to scold again, before finally vanishing. A great deal of alarm was shown by mallard duck with young in the vicinity. A number of possible lairs have been located along the city branch and main line of the canal.

OBITUARY
Alfred A.P. Slack (1913-1998)

Alfred, or Alf as he was known to everyone, was born in London and educated at Stationers' Boys School and the University of London. He moved to Scotland in the late 1930s and stayed in Glasgow. During the Second World War Alf was a conscientious objector and he worked in farming and forestry in the Bridge of Orchy area. After the War Alf spent much of his professional life as the principal of Glasgow Tutorial College. In 1948 he joined the Glasgow Natural History Society and was elected president in 1970.

Alf had two passions: climbing mountains and hunting for plants, especially arctic-alpines. He had climbed all the Munros by 1950 and was the 15th person known to have done so, although he did not inform the Scottish Mountaineering Club till 1990. Alf once assured me that he had climbed all the Munros in both summer and winter; this is not a feat achieved by many. His two most noteworthy discoveries, more correctly called rediscoveries, regarding the Scottish flora were a result of his persistence and keen powers of observation. First in 1951 he found *Homogyne alpina* in the Clova Hills which was a confirmation of George Don's record made before 1814; Basil Ribbons (1952) published a note on Alf's discovery. The second was the group of rare plants on the limestone of Ben Sgulaird including *Oxytropis halleri*, first seen in the vicinity by James Robertson in the mid 18th century (Slack 1958; Slack and Dickson 1959). Alf took many photographs of mountain plants and grew many also. The Clova *Homogyne* is to be found growing vigorously in not a few Scottish gardens because Alf had it in cultivation and gave pieces to his friends.

I and other science graduates of Glasgow University in the 1950s and 60s, such as David Walkinshaw who became a biology teacher at Lenzie Academy and Euan Todd who became president of the Ottawa Field Naturalists Club, have very good reason to be grateful to Alf. He and Mattie, his wife, befriended us and took us on various botanical excursions round Scotland. Our floristic knowledge was greatly increased by these trips which were made very congenial by Alf's easy going manner and Mattie's kindness. He passed on his great knowledge of field botany in other ways such as by teaching courses at the Scottish Field Studies Association.

Alf's short list of publications is not commensurate with his knowledge and experience. Other than the two already mentioned, in the *Glasgow Naturalist* there was his account (1966) of *Pinguicula lusitanica* in Britain. His interest in botanical exploration of Scotland led him to publish on John Lightfoot (1986). There were six accounts with maps of arctic-alpines in the volume on *Scarce Plants in Britain*. His major contribution, however, concerned *A Map Flora of Mainland Inverness-shire* (Hadley, 1985). That his name does not appear on the title page of that work is unfortunate because Alf devoted much time and energy to the preparation of both the maps and the text.

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Jim Dickson

BOOK REVIEWS

Compiled by RUTH DOBSON

Weather (Collins Gem Photoguide)

STORM DUNLOP

Harper Collins, London, 1996, 256 pp., paperback with numerous colour photographs. ISBN 0 00 470829 6, £3.99.

This weather photoguide is divided into 17 sections dealing with all aspects of weather and weather conditions the reader is likely to encounter. As with other photoguides the introduction is full of information and a glossary is supplied, together with a section on weather records worldwide, at the end of the book. The photographic illustrations are particularly good and some would look superb enlarged and framed.

Joyce Alexander

Savage Earth

ALWYN SCARTH

Harper Collins, London, 1997, 192pp., hardback with many colour diagrams and illustrations. ISBN 0 00 220106 2, £16.99.

This book explores the impact of earthquakes, volcanoes and ocean tsunamis on the human experience, from an accessible scientific viewpoint. The events are clearly illustrated and also include in some instances personal accounts. Perhaps this provides some humanity to the cold exploration of plate tectonics, but it does invade the ordered study of the subject. The reviewer did not like the layout of the book: it must be considered as "the book of the ITV series", but in saying that, to a general reader the descriptions are easy to understand and "exciting" in presentation. The diagrams make up for the vagaries of the design and are especially accessible and easy to understand. An example of the formation of volcanoes in the subductive zone is illustrated far better than with word description. The book's other value is that it reveals secondary influences on disaster magnitudes, for an example city fires caused by heaters becoming knocked over in the earthquake. The book therefore provides an understanding of why some earthquake incidents are so much worse than others and why poor "shanty towns" may be devastated whilst business areas may survive. Chronologies of events, a glossary and index increase the accessibility of the subject and the fullness of exploration cannot really be faulted. But the layout of the book dampened the pleasure of the book on a subject for which the reviewer has personal enthusiasm. The book is colourful, diagrammatic and vivid in presentation but it is too like using a "windows" computer system. The conservatism of this reviewer rebelled against the layout and especially found printed text across photographic images on p.48, 60 and 61, 64 and 65, irritating. But the criticism is personal and the book is a significant contribution to a subject too often buried in academic overkill.

Brian S. Skillen

The Wildfowl & Wetlands Trust

DIANA FOWLER & SIMON ECKLEY (Compilers)

The Wildfowl & Wetlands Trust, Chalford, Stroud, 1996, 128 pp., softback with over 200 black and white photographs. ISBN 0 7524 0616 7, £8.99.

Since 1945, from an initial modest reserve for migrating geese at Slimbridge on the Severn estuary, the late Sir Peter Scott and his colleagues developed a network of eight Centres. These are active in conservation, research, teaching (both children and adults) and training both in Britain and internationally. This book records this remarkable and continuing achievement, mainly by extended legends to numerous archive photographs, cartoons and

Normal R. Grist

Collins Safari Guides
Larger Animals of East Africa

DAVID HOSKING & MARTIN B. WITHERS

Harper Collins, London, 1996, 160 pp., softback with numerous colour plates. ISBN 0 00 220036 8, £9.99.

Common Birds of East Africa

MARTIN B. WITHERS & DAVID HOSKING

Harper Collins, London, 1996, 160 pp., softback with numerous colour plates. ISBN 0 00 220034 1, £9.99.

These two attractively produced books provide photographic guides to the common birds and mammals of East Africa. The photographs were almost all taken by the authors, which is a remarkable achievement, and they cover 76 mammal and 360 bird species. All are well chosen as guides to identification, with good lighting and sharp focus. The text gives a rather predictable account of each species, covering general appearance and main features of ecology. The mammal volume has a rather tedious list of key facts for each species, and most readers would probably have preferred a distribution map to show where each species is likely to be found. Also an indication of whether it is a male or female animal in the photograph would sometimes help. The mammal volume covers all the common species a visitor is likely to encounter on a short visit. The bird volume has a larger problem, in that there are over 1000 species found in Kenya alone, and so the selection of only 360 from the whole region has been a very incomplete coverage. But the authors have done a sensible selection here, and all the commonest species are included. Usually only the male is illustrated, and female and immatures are dealt with very briefly in the text. For the price, these are handsome books. I hope this does not sound patronising, but I think these books would be most suitable for people with only a passing interest in natural history. Anyone with a deeper interest would quickly become frustrated at seeing birds they could not identify, or smaller mammals that were not included. Some of the many conventional field guides would probably be a better choice for them, and the authors recognise this and include a good bibliography of reference books.

David C. Houston

Collins Watch Guides
Wildlife of the Town

GUILHEM LESAFFRE (Illustrated by FRANÇOIS DESBORDES *et al.*)

Harper Collins, London, 1997, 48 pp., softback with numerous colour plates. ISBN 0 00 220091 0, £5.99. (First published in French, 1995).

Whales, Dolphins and Seals

FRANÇOIS MOUTOU (Illustrated by FRANÇOIS DESBORDES *et al.*)
Harper Collins, London, 1997, 48 pp., softback with numerous colour plates. ISBN 0 00 220089 9, £5.99. (First published in French, 1995).

These are new titles in the series "*Adventures in the Natural World*", a pocket size edition that includes *Birds of the Countryside, Seashore*, and *Flowers of the Wayside*. Their spiral binding allows the books to lie flat or fold back to "keep the place" when put into a pocket. Together with the series' waterproof pages this format would make valuable field guides; their contents, however, are more appropriate as an introduction to the topics for school children and teachers.

Lavishly illustrated and with text broken into short mind bites, they will appeal to those who prefer to pick and mix their information rather than to settle down for an extended read. *Whales, Dolphins and Seals* would interest parents and children who have spotted a seal on our coast and want to find out more. *Wildlife in Towns* is perhaps less useful. A glance at the contents page shows the limit of wildlife included; there are spiders and ladybirds but no bees and wasps; butterflies but no moths; trees only as an adjunct to birds...

The books have been well translated from French and are easy to read. They contain suggestions for further reading and addresses (in this country) to contact to find out more. The European slant may result in some children expecting to see beech martins in our cities, but my main criticism is of the confusion on the pages showing food chains. In schools, the convention is for arrows to indicate the direction of energy transfer from the food organism to the consumer. In both these books the arrows point in the opposite direction.

Despite all my objections I have no hesitation in recommending the books of this series for use in schools. Their Glossaries and Indexes make them particularly useful for project work. Future titles are to include *Ponds, Wild Fruit and Berries*, and *Edible Mushrooms*. These, with their more focused subject matter, together with their "all-weather" format should become useful additions to environmental studies field trips.

Lyn Dunachie

The Complete British Wildlife Photoguide

PAUL STERRY

Harper Collins, London, 1997, 384 pp., softback, fully illustrated with colour photographs. ISBN 0 00 220071 6, £12.99.

As a celebration of British natural history, this book certainly succeeds. Over 1000 colour photographs make it a very attractive book and the price of £12.99 makes it an ideal purchase for the amateur naturalist. The author has been careful to choose those species most likely to be encountered by the amateur naturalist and opens with a description of the major habitat types likely to be encountered in Britain and the key species to look out for. All the major groups are covered from fungi and plants to invertebrates, fish, reptiles, amphibians, birds and mammals. Coloured symbols in the top left hand corner of each text page make convenient thumbnail indicators of each group. The photographs are well laid out with the text opposite, which although deliberately condensed, gives some useful information about each species illustrated. An additional section offers some advice to the would be wildlife photographer regarding necessary equipment and basic technique. The author recognises that there is some disagreement about the usefulness of photographs as aids to identification. Certainly for more conspicuous species such as birds, mammals and higher plants, photographs are very useful and in many cases more accurate and realistic than artwork. However, in the case of insects, other invertebrates, lower plants and fungi, photographs can be very misleading or downright useless. Used in conjunction with other more detailed field guides and keys, this photoguide would indeed be a useful addition to the naturalist's collection, although perhaps not as essential as the cover claims.

Andrew Kelly

Beneath British Seas

ALAN JAMES

Swan Hill Press, Shrewsbury, Shropshire, 1997, 144 pp., hardback with full colour photographs. ISBN 1 85310 761 1, £19.95.

This is a full colour photographic record of some of the marine life the author has encountered on dives around the British Coast. Eleven different sites are described and there is also a chapter on underwater photography.

There is a brief description of the diving at each site and of the type of photographs the diver was taking. This would be of interest to other divers and photographers, although the sites described are well known ones. What is evident is the author's fascination for and love of marine life. He obviously has endless patience with his camera and the resulting photographs show some stunning and sometimes surprising images of marine life.

This book makes no attempt to be a British dive guide, or to be a marine identification guide. The photographs, however, are wonderful and the colour reproduction is remarkable. Certainly, the photographs in this book show that the beauty, colour and diversity of marine life in British waters is equal to any found in coral reefs in more exotic areas of the world.

The pictures in this book should be seen by everyone whether or not they are familiar with the marine world. The more that is known about the beauty and wonder of the world under the sea the more people will want to speak out for the cause of marine conservation.

Mary Child

A Student's Guide to the Seashore

J.D. FISH & S. FISH

Cambridge University Press, Cambridge, Second Edition 1996, 564 pp., softback with 341 line drawings. ISBN 0 521 46819 1, £19.95 (hardback ISBN 0521 46279 7, £55.00).

In the present reviewer's experience, the first edition of 'Fish & Fish' (destined always to be a source of undergraduate amusement?) was ideal for students conducting field-work on the seashore, since, as well as being an effective identification guide, it provided much more information on the biology of individual organisms than rival books.

The second edition is even better. It covers a larger number of plants and animals (over 600) than the first (over 500), but the main improvement is the addition of straightforward dichotomous keys which in most cases take the user to species level. The text has been revised completely. Nomenclature, taxonomy and information on life-cycles and ecology have all been updated, as have the reference lists and bibliographies that are another useful feature of this book.

The illustrations are exclusively line drawings, but there are many of these; they are detailed and accurate, and they often draw attention to characters of diagnostic importance. For the second edition, new drawings have been added and more accurate versions of some first edition drawings have been supplied. One deficiency that has not been corrected is the absence of scale bars from all the drawings, which can be a source of real confusion to inexperienced users. The authors acknowledge but do not justify this puzzling omission. The second edition lacks the four plates of colour photographs that were in the first. However, this is no great loss, since only a tiny proportion of organisms were included in the original plates. For many seashore organisms, accurate line drawings are an acceptable alternative to colour photographs and are certainly preferable to the inaccurate, partly impressionistic colour drawings that diminish the usefulness of other seashore guides.

This is an excellent book for the intended readership, i.e. students and their teachers. It can also be recommended to interested amateurs.

Iain C. Wilkie

Collins Nature Journeys: The Ultimate Guide to Wildlife Travel

DWIGHT HOLING (Consulting Editor)

Harper Collins, London, 1997, 288 pp., hardback, lavishly illustrated in colour. ISBN 0 00 220108 9, £18.99.

"We need wilderness, whether or not we set foot in it. We need the possibility of escape as surely as we need hope". So says one of the quotations, which intersperse this book and provide the vision for the development of ectourism.

Chapter 1 explains that ecotourism, developed in the 1980s and now established, is a system whereby tourists to areas rich in wildlife, mostly national parks, double as conservationists, the money brought in paying local people to conserve them, thus creating jobs and a sustainable infrastructure. This depends on careful management and on travellers acting with sensitivity to the environment and local cultures. If local people see that "wildlife pays, then wildlife stays". Numerous organisations from government bodies to international conservation groups and ecotour operators are involved in ecotourism planning. Further chapters deal with all practical details including choice of operator, health, money, background preparation and what to take, as well as types of travel e.g. hiking, cycling, boating, camping, cruising etc. Ecotourism can be as adventurous as you want to make it.

The main part of the book describes 68 wildlife destinations, by continents, throughout the world, at least two pages being devoted to each. These give a map, description of the area with local knowledge and practical information about how and when to visit. Unfortunately the maps do not always show all the information in the text. The excellent and lavish illustrations on every page are chosen to show the best of each area's scenery, typical habitats and flora and fauna.

The foreword warns that "this book may be the start of something". This could well be true, as it provides both inspiration and information. For those of us who can no longer contemplate going on such excursions this is a great book to browse through, "perchance to dream".

Ruth H. Dobson

Garden Wildlife (Collins Nature Guide)

MICHAEL CHINERY

Harper Collins, London, 1997, 256 pp., softback with numerous coloured photographs. ISBN 0 00 220072 4, £7.99.

This is one of the excellent Collins Nature Guides. The book covers nearly 400 species of a surprisingly wide spectrum of wildlife in the gardens of Britain and Europe including mammals, birds, reptiles, amphibians, spiders, beetles, butterflies and moths, flies, worms, molluscs, woodlice and flowering plants. Each section is colour coded for ease of reference. At the start of the book there is a section on wildlife gardening which advises on the best shrubs and plants to include in your garden together with hints on attracting and feeding birds, bats, butterflies, bees and wasps. There is also a short section on the wildlife pond.

Some readers might prefer more information on British species. If the reader is interested in mammals, there are only 15 species listed, one of which is the beech marten which is not found in this country. If you live in the UK and are not likely to spend time in gardens on the continent you might prefer to have more information in the book relating to species that you are more likely to find in your own garden.

Many of the insects listed are of southern European distribution. Stay-at-home gardeners might come across these species should global warming occur, or more likely specimens of the attractive green shield bug *Nezara viridula* or

other exotics when they bring home their foreign grown vegetables from the supermarket.
In conclusion I consider the book a good buy at £7.99.

Ian C. McCallum

Scottish Plants for Scottish Gardens

JILL, DUCHESS OF HAMILTON (Description of plants by FRANK PERRING; plant checklist by RICHARD PANKHURST and CHRIS PRESTON; Gaelic names by JOAN CLARK; editor NORMA M. GREGORY).

The Stationery Office (on behalf of the Royal Botanic Garden), Edinburgh, 1996, 104 pp., softback with many colour photographs. ISBN 0 11 495803 3, £12.95.

The Duchess of Hamilton explains the uniqueness of the Scottish flora and urges those living in Scotland to consider growing native rather than introduced species in order to retain them for the future, as well as to enjoy them in the present.

In order that the non-specialist can distinguish between native and alien plants there is a check list of 1,085 indigenous ferns and flowering plants arranged alphabetically by Latin names, followed by English, Gaelic and Scots. The introduction by the Duchess is quite short, the main part of the book being a description of just over 100 native plants, each with a colour photograph. These are arranged in two sections, first trees and shrubs, then wild flowers, the plants being arranged in alphabetical order in each section using the Latin names. For each plant there is a colour photograph, some of which are excellent, but many have been reduced too much to make out detail and, as always with photographs, it is not possible to determine the scale. However, the description of each plant remedies this and gives information about habitat, time of flowering, suitability for growing in gardens, methods of propagation and pollinators. The alphabetical index of the plants described has both Latin and English names and is easy to use.

This is an attractive and useful book.

Jean M. Millar

Scottish Wild Plants. Their history, ecology and conservation

PHILIP LUSBY & JENNY WRIGHT (with photographs by SIDNEY J. CLARKE)

The Stationery Office (on behalf of the Royal Botanic Garden) Edinburgh, 1996, 115 pp., softback with numerous colour photographs and maps. ISBN 0 11 495802 5, £12.95.

The aim of this book is to raise the appreciation and understanding of the Scottish flora, which, it is hoped, will contribute to its conservation. Its authors are well suited to this task, since they are members of the Scottish Rare Plant Project, based at the Royal Botanic Garden Edinburgh.

The book starts by explaining how plants colonised Scotland after the last Ice Age, resulting in some unique assemblages of plants from widely distant geographical sources. Dividing the country into five main regions, the influence of geology, topography and climate on the distribution of plants is discussed. The human influence and the need for conservation and public understanding is stressed.

The main part of the book gives descriptions of over forty of the most interesting plants selected from our diverse Scottish flora. These are accompanied by excellent colour photographs especially commissioned for this publication. Many of the plants chosen are rare, but although their habitats are described, their precise locations are not revealed. A wealth of information is given about each plant, including a history of its discovery in Scotland, distinguishing features of closely related species, details of habitat preference and time of flowering. A fascinating book, and one which I would recommend to anyone interested in Scotland's natural history.

A minor defect is the absence of an index to the plants described. And the rather weird cover shows One-flowered Wintergreen (*Moneses uniflora*), a plant of pine forests, seemingly growing on the fringe of an exposed upland lochan!

Edna Stewart

A colour atlas of plant structure

BRYAN G. BOWES

Oxford University Press, Manson Publishing, Oxford, 1996, 192 pp., softback with 389 colour and black and white illustrations. ISBN 1 874545 16 2, £24.95 (hardback ISBN 1 874545 20 0, £48.00).

This book, by a former senior lecturer at the Botany Department of Glasgow University, is intended to provide a concise and highly illustrated summary of the structure of vascular plants. It is aimed primarily at university level students, as an introductory text or for revision, but also as a ready reference source for other professional workers in related fields.

The book provides an extremely comprehensive overview of the major aspects of plant structure including cell structure and growth form, covering roots, stems and leaves, with a final chapter on flower structure and reproduction. The text is concise but extremely comprehensive, and additionally very well cross referenced, although it may have beginners (or more experienced field botanists!) reaching for school botany textbooks to check up on the basics! For the amateur natural historian and other interested readers the high quality, attractive illustrations, many in colour and often with an abstract beauty, are the key feature of the book and make for an enjoyable and stimulating read.

Any member wishing to gain an overview of the inner workings and structure of plants, presented in an attractive, well illustrated format, would be well advised to get a copy of this book.

Keith Watson

Mushrooms and Toadstools (Collins Gem Photoguide)

PATRICK HARDING

Harper Collins, London, 1996, 256 pp., paperback with numerous colour photographs. ISBN 0 00 470934 9, £3.99.

Of about 4,000 species of mushrooms and toadstools occurring in Britain, 236 species are described and illustrated in this book. There is an explicit introduction which gives information on the structure of fungi, their diverse habitats and gives a useful key to their identification. On the whole the photographs are clear, showing the fungi in their natural habitats and, where appropriate, showing the undersides of their caps. The photographs are further enhanced by individual texts for each species giving details of their size and habitat, whether edible or poisonous, and naming species similar to those described.

Joyce Alexander

Common Families of Flowering Plants

MICHAEL HICKEY & CLIVE KING

Cambridge University Press, Cambridge, 1997, 212 pp., softback with numerous black and white illustrations. ISBN 0 521 57609 1, £14.95. (hardback ISBN 0 521 57281 9, £40).

This book deals with 25 families rather than the 100 described in the authors' previous book of similar purpose. The accounts of the families are preceded by 30 pages of "general botany" of which 22 are devoted to illustrations of vegetative and floral morphology. A 12 page glossary succeeds the accounts.

For each family there are discussions of distribution, general characteristics, economic and ornamental plants and classification. For each chosen species there is consideration of distribution, floral formula, flower and inflorescence, and pollination. Alternative flowers are mentioned. There are clear, black and white illustrations of the habit, flower, half flower, fruit and details of the carpels and stamens.

As is usually the case in such books, seeds as distinct from fruits are given short shrift. There are good drawings of the seeds of *Ricinus* and *Euphorbia helioscopica* and that is all. In Caryophyllaceae the seeds are often highly significant in taxonomy at various hierarchical levels. Beautifully papillate, reniform seeds are found in many but not all members of this family including both *Silene dioica* and *Cerastium tomentosum*, the two species described in the book. There is space where the seeds could have been shown.

Common Families of Flowering Plants is a useful book for teaching of basic knowledge and can be strongly recommended.

James H. Dickson

Dandelions of Great Britain and Ireland (BSBI Handbook No. 9)

A. A. DUDMAN & A. J. RICHARDS (illustrated by OLGA STEWART)

Botanical Society of the British Isles, London, 1997, 344 pp., softback with numerous line drawings, silhouettes and maps. ISBN 0 901158 25 9, £17.50.

This, the latest of the BSBI Handbook series, deals with perhaps the most taxonomically difficult genus in the British flora. It is the culmination of over thirty years work, mainly by one of the authors (AJR), ably assisted latterly by his co-author and, until his untimely death, C. Haworth. These workers have over the years achieved an understanding of the British *Taraxacum* flora which has to date resulted in the description in this handbook of some 200 - 300 taxa.

An introductory section deals with, among other aspects, the history, taxonomy and ecology of dandelions, emphasising the role played by apomixis, responsible for the great number of microspecies of *Taraxacum* in our flora.

Although the authors emphasise the great difficulty of creating effective keys for identification, they have nevertheless produced two, one multi access and the other dichotomous, which should at least enable the student to assign a specimen to one of the Sections into which the genus has been divided. More precise determination may not prove to be easy for the non-specialist.

The main part of the handbook is devoted to species descriptions, each accompanied by an illustration of a pressed specimen in silhouette and, in most cases, a drawing of an involucre to show the form of the bracts. Whether these illustrations will prove really helpful to the average field botanist is questionable. I suspect that future work will proceed much as before, with non-specialists collecting and preserving their local dandelions for submission to the experts for naming.

The volume is the same size as the Handbook No. 8 on Potamogetons, rather larger than the earlier works in the series. For anyone with an interest in this rather neglected plant group this volume is an essential addition to their library. The authors are to be congratulated on producing a very lucid account of the British dandelions. However, it must be emphasised that species identification is far from easy. To quote the authors' own words "Dandelions are difficult".

Allan Stirling

Spiders (Collins Gem Photoguide)

PAUL HILLYARD

Harper Collins, Glasgow, 1997. 254 pp., softback with line drawings and colour photographs. ISBN 0 00 470904 7, £3.99.

Starting with concise accounts of the anatomy and biology of spiders and advice on how to find and keep them, this pocket-sized (84 x 117 mm.) guide proceeds to illustrate their great diversity by describing some 200 species (70 from Britain) along with notes on their distribution and bionomics and a colour photograph of each in its habitat. A short final section characterises examples from eight other arachnid groups and a bibliography and glossary conclude the book.

Ronald M. Dobson

The Natural History of Spiders

KEN & ROD PRESTON-MAFHAM

Crowood Press, Marlborough, 1996, 160 pp., hardback, numerous colour plates and line drawings. ISBN 1 85223 966 2, £16.99.

Spiders, more than any other group of arthropods, are repugnant to many people. This latest, lavishly-illustrated volume by the naturalist/photographer authors could do much to dispel such irrational emotions. After a general introduction the text proceeds to brief summaries of the structure, physiology and classification of spiders and these are followed by sections on feeding, reproduction, parental care, defensive behaviour and ecology. Examples drawn from all over the world result in a volume of absorbing interest. The colour photographs are generally outstanding although a few (e.g. p. 135) seem unclear. The line drawings by Michael J. Roberts are excellent.

Errors are few: the cloacal pouch is not a cloaca (pp. 14, 17); *Pholcus phalangioides* is misspelt (p. 78) and there is some confusion between fangs and pedipalps (p. 96). The glossary of only 12 terms is inadequate and superfluous; there are no references or guides to further study and only two other arachnologists are acknowledged. Some may fault the somewhat racy presentation of the text with its occasional lapses into subjectivity but, these criticisms apart, the book is well-worth having for the wealth of information it contains.

Ronald M. Dobson

Insects (Collins Gem Photoguide)

MICHAEL CHINERY

Harper Collins, London, 1997, 256 pp., paperback with numerous colour photographs. ISBN 0 00 470939 X, £3.99.

Given the enormous size of the insect kingdom, this book, of necessity, details only a fraction of the 100,000 species to be found in Europe. However, those described are commonly found in Britain and Europe and a good description is given of each species along with a clear photograph. The contents key gives a brief description of the 15 orders dealt with and the introduction gives a description of the insect body and insect life histories.

Joyce Alexander

Field Guide to the Dragonflies and Damselflies of Great Britain and Ireland

STEVE BROOKS (General Editor, with illustrations by RICHARD LEWINGTON)

British Wildlife Publishing, Hook, Hants., 1997, 160 pp., softback with numerous colour photographs and illustrations, line drawings and maps. ISBN 0 9531399 0 5, £18.95.

This small volume is much more than a field guide to the 38 resident and 9 migrant species of Odonata occurring in the British Isles as it incorporates a wealth of information on the general biology of each species, supplied by a panel of specialists.

Starting with an extended introduction dealing with life history, distribution, habitats and legal aspects, the book proceeds to a brief summary of the main dragonfly sites in Great Britain and Ireland. This is followed by an illustrated key to the species of dragonfly larvae and a key to the families of adults. A glossary of terms is included.

The main section of the book consists of accounts of individual species, with anatomical descriptions and notes on similar species, supported by detailed comments on their status, conservation, ecology and behaviour. Each species is illustrated by somewhat enlarged, excellent colour plates, usually of both sexes, and sometimes of colour variants and immatures. Critical diagnostic characters are often illustrated and small maps of distribution with flight times are supplied as appropriate.

In conclusion, this is an excellent production at a reasonable price.

Ronald M. Dobson

Provisional atlas of the aculeate Hymenoptera of Britain and Ireland Part 1

ROBIN EDWARDS (Editor)

Bees, Wasps and Ants Recording Society, Huntingdon, Biological Records Centre, 1997, 139 pp., softback with 56 distribution maps. ISBN 1 870393 39 2, £6.00.

The latest publication from BRC, of what is now a series of significant value for the study of British insects, is another tribute to the industry of the enthusiasts who contribute the results of their field work, and to those who collate them into a publishable form. This atlas is the product of hard graft on the part of the well-known core group of the Bees, Wasps & Ants Recording Society and the numerous members that send in their observations, as is readily acknowledged by the editor. The so-called provisional atlases have grown from being just distribution maps, with minimal associated information, to small scale revisions of current biological knowledge of the group under consideration. Included are the most recent checklist names, red data book status, habitat and flight periods. Added in this selection of species are data on feeding habits and nesting biology.

There is an extensive bibliography and an index to plant names. The plants mentioned are generally those whose flowers are visited by the bees or wasps for feeding and in some cases including an analysis of the pollen collected for provisioning their nests. This atlas provides an interesting cross-section of the different biologies found within the aculeates and may entice some naturalists to take them up for individual study. Perhaps this is the reason, which is not specified in the introduction, behind the electic mix of 55 species from 7 different families.

E.G. Hancock

The distribution of aquatic bugs (Hemiptera-Heteroptera) in Scotland

THOMAS HUXLEY

Scottish Natural Heritage Review, No. 81, Scottish Natural Heritage, Perth, 1997, 99 pp., softback with numerous tables, maps, graphs and drawings. [No. ISBN number, no price given].

Tom Huxley has not just produced an atlas of distribution but also a blow by blow account of the entire process by which these kinds of things are produced, featuring Scottish water bugs as examples. This describes the required effort put into such a project as well as the general ethos behind doing it in the first place. Part of this, of course, is to provide a base line of current knowledge from which more detailed studies can develop. To this end considerable pains have been taken to trace and analyse the more dubious or unlikely records. These include the rogue species that gets regurgitated from one original well-meaning (or perhaps just wrong) published record until it reaches the giddy heights of assumed fact, simply by having been repeated often enough. Someone then has to take the trouble to sit down and work out the whodunit of the situation. It involves literature searches, hunting in museum basements and ultimately making decisions which one is prepared to defend. These must be amongst the most time-consuming elements of such a project but possibly the most satisfying to resolve.

As with all the similar mapping productions there are great gaps of coverage which no one person can hope to fill. In the case of the less popular groups, recruiting others to help can be a frustrating experience and one approach is to do what one can and then get something out into print. This is usually guaranteed to bring out of the woodwork numerous people who will tell of their own private special sites of interest which they had assumed to be general knowledge, especially to the 'expert'. The mapper then has to smile politely while filling in some more blank squares knowing that no other strategy will persuade some people to release their data! A more positive result of producing something in a tangible form is in recruiting new recorders to help fill these gaping holes. Something in the hand is a great asset from which the only way is forward. At the end of another decade the picture will look more than twice as good as today's and the profile of an interesting and under-studied section of the insect world will have been raised for the benefit of species and habitat conservation.

E.G. Hancock

Butterflies of Britain & Europe (Collins Field Guide)

TOM TOLMAN (Illustrated by RICHARD LEWINGTON)

Harper Collins, London, 1997, 320 pp., hardback with 106 colour plates and over 400 distribution maps. ISBN 0 00 219992 0, £17.99.

This book replaces the original Field Guide to the Butterflies of Britain & Europe by L.G. Higgins and N.D. Reilly, first published in 1970, which became the standard work on the subject.

This new publication has achieved its aim of being more than just a field guide. It is well set out and includes much useful information.

There is some general information on the anatomy and life cycle of a butterfly. For each species, a description, information on its flight period, habitat, life history, range and distribution, with a map, are given. The maps are too small to show any detail, but this is more than made up for by the beautifully illustrated plates by Richard Lewington of almost all the species described. There is also a checklist, a glossary and a bibliography pointing the reader to more detailed information elsewhere.

The book covers the 440 species of butterflies found within the geographical area covered, which includes the Canary Islands, Maderia, the Azores, parts of Morocco, Algeria and Tunisia as well as Europe itself. This gives a better idea of the true status of some of our rarer European species, which may be on the edge of their range in Europe, but could be common in north Africa.

As with any book covering a large geographic area and using common as well as scientific names, there is a problem. For example, if you look up *Aricia artaxerxes* under its common name, Northern Brown Argus, you will not find it. It is listed as the Mountain Argus, relating to a subspecies of *A. artaxerxes* which occurs in the Pyrenees, the Alps and elsewhere. This I found a little bit annoying, as it is possibly the only British endemic butterfly species! As a field guide, it is a little bit on the heavy side to carry about in the field. However, apart from these minor criticisms, it is a useful book to get a general overview of European butterflies.

Richard Sutcliffe

Sharks & Rays: The Ultimate Guide to Underwater Predators

TIMOTHY C. TRICAS, KEVIN DEACON, PETER LAST, JOHN E. McCOSKER, TERENCE I. WALKER & LEIGHTON TAYLOR.

Harper Collins, London, 1997, 288 pp., hardback with many colour photographs and illustrations. ISBN 0 00 220104 6, £16.99.

I must admit to being more than a little suspicious of a title which includes the word 'ultimate' in it. So it was with more than a little trepidation that I opened up this book. However I found myself pleasantly surprised when I opened it!

The layout of the book has a modern feel to it with each of the eight chapters being split up into shorter more manageable sections. The chapters deal with Understanding sharks and rays, Our relationship with sharks and rays, In the field (which deals more with diving matters), Sharks (the anatomy & biology of), Rays (anatomy & biology), Sharks field guide, Rays field guide and Encounters with sharks and rays.

Special mention needs to be made of the quality of the photographs, some of which are simply stunning. Even with species where no photographs are available (and there are not many) the colour illustrations are very good without being stylised which is a common feature amongst books of this type.

However, care should be used when using the field guides because only 56 shark species and 20 ray species are described in any detail. When you consider that there are actually 70 plus species of shark and 40 plus species of ray found in European waters alone then the shortcomings of these field guides become apparent. It should also be noted that many of the species featured are to be found in American waters only.

Having said that, however, it is appreciated that this book is not aimed at dedicated shark fanatics but is aimed in a non-scientific way at the general public. This can only be good at this time because many species of shark and ray are under threat from over-exploitation and sharks and rays need all the 'new' friends they can get.

Perhaps not the 'ultimate' book on underwater predators but all in all this is a good introduction to this fascinating class of animals, informative without being too heavy and unlike many other books of this 'ilk' it does not tarry overlong on the more sensational aspects of shark behaviour.

Bill Little

Fish of Britain & Europe (Collins Pocket Guide)

PETER J. MILLER & MICHAEL J. LOATES

Harper Collins, London, 1997, 288 pp., paperback with over 2000 colour illustrations and numerous distribution maps. ISBN 0 00 219945 9, £12.99.

It is amazing to think that there are 753 species of fish within European waters! This book describes all of them from small humble minnows to the feared Great White Shark. Fish from both marine and freshwater environments are included and there are separate well illustrated keys to each group. There is a good general introduction describing the different groups of fish, their biology and habitats. There are brief descriptions of each species including, where appropriate, diagnostic features which are complemented by Michael Loots colour paintings. Unfortunately, on a few pages, some of the text is printed on top of the paintings, making it very difficult to read. All the distribution maps which are given are far too small. In a species with a restricted range it is difficult to see anything on the map at all!

A useful book for someone with a general interest in natural history, but many readers will want more information than is given on individual species.

Richard Sutcliffe

The introduction and naturalisation of birds

J.S. HOLMES & J.R. SIMONS (Editors)

The Stationery Office, London (for BOU-JNCC), 1996, 136 pp., softback with graphs, tables and diagrams. ISBN 0 11 702041 9, £20.00.

This publication is essentially the proceedings of a British Ornithologists Union and Joint Nature Conservation Committee conference on the world-wide problem of alien introductions and their effects on native fauna. There are nowadays few countries without alien introductions but whether these represent a real threat to any native species is often hard to establish. The trade in captive and cage birds is vast and, if anything, appears completely out of control. Most introductions are of gamebirds and waterfowls and the treatment and attitude to such introductions vary according to perceived circumstances. There has been much recent debate on the Ruddy Duck and its hybridisation with White-headed Duck in Spain while in my opinion the Canada Goose and its ability to hybridise with our native Greylag Goose, or the Feral Pigeon and its hybridisation or competition with our native Rock Dove, has received no scientific study at all. Increasing goose numbers *have* been studied since they may pose a monetary threat to agriculture.

The sixteen or so collected contributions here discuss everything from the practical and the legal to the theoretical and represent a solid contribution towards the understanding of such avian events.

I consider this publication somewhat overpriced. At about half the current price it might become a more accessible reference for those involved in conservation measures in places other than the British Isles.

Bernard Zonfrillo

Rare Birds in Britain & Ireland. A photographic record

DAVID M. COTTRIDGE & KEITH VINICOMBE

Harper Collins, London, 1997, 192 pp., hardback with 96 coloured plates showing about 500 species. ISBN 0 00 219976 9, £25.00.

Rare birds can turn up anywhere and are often in plumage which seldom is shown in popular field guides. This book shows mainly recent colour photos of rare birds on the British List and many are in "difficult" plumage which is a good excuse in itself for such a collection. Not only are the pictures useful but the identification comments in the text are both helpful and informative. The photos, all taken in the British Isles, vary from excellent to a bit on the fuzzy side but only a few are in the latter category. My only criticism is that according to the authors there is nowhere from between north Orkney south to Flamborough Head where one has a chance of seeing rarities. Thus Isle of May, Fife Ness, Balranald, Hound Point etc. don't rate a mention. Strange that Scotland should be so ignored when some of the included rarities such as Snowy Owl, Gyrfalcon, Parrot Crossbill, Bluethroat etc have actually bred here in recent decades. The authors should perhaps spend more time in Scotland. That apart all birders will want this book, no doubt about that, and the price represents good value for money.

Bernard Zonfrillo

Wings Guide to British Birds (a Channel Four book)

DOMINIC COUZENS

Harper Collins/R.S.P.B., 1997, 251 pp., softback with many colour illustrations, line drawings, colour photographs and maps. ISBN 0 00 220069 4 £12.99.

This book is a must for every bird watcher and is a mine of useful information. Particularly useful are the maps showing the normal distribution of species and the season of the year during which they are likely to be found. The illustrations are excellent showing male, female, juvenile and seasonal plumage. There are useful notes on the habits of birds such as methods of feeding, calls, flying and breeding behaviour. Particularly useful are the sections on gulls and waders. The colour photographs, colour illustrations and line drawings are of good quality and accuracy and the book is further enhanced by a valuable glossary and a good index. It is light and easy to carry on field excursions.

Margaret M.H. Lyth

Birdwatching. The ultimate guide to the birds of Europe

ARNOUD VAN DEN BERG, TOM VAN DER HAVE, GUIDO KEIJL & DOMINIC MITCHELL

Harper Collins, London, 1997, 288 pp., hardback with colour photographs and maps for each species. ISBN 0 00 220093 7, £16.99.

An excellent introduction to birds and bird-watching, containing chapters on just about everything the enquiring mind would ask about birds. There are also chapters on equipment and photography as well as lesser topics such as birds in art and in folklore.

The "meat" of this book however, is in its "Habitat Birdfinder" chapter, illustrated with superb photographs by the senior author and useful paintings of related species. The information is generally accurate and concise. However, the subtitle "the ultimate guide to the birds of Europe" seems a bit extravagant. Many species are not illustrated and Roseate Tern for example isn't mentioned at all anywhere, although Resplendent Quetzal is!

The use of habitat to locate birds is also a major failing. Someone feeding Mute and Whooper Swans in urban Glasgow would have to look at two different habitat sections to locate each species. Anyone seeing a Wren on the coast or on an island would have to consult the "woodland" section to find a photo. Why straightforward systematic relationships are not used, I find annoying. Birds frequently change their habitats as well as their plumage and habitat alone is not a good basis for identifying birds. That being so, this is still a useful book for young or novice bird watchers and is reasonably priced.

Bernard Zonfrillo

Water Voles

ROB STRACHAN

Whittet Books, London, 1997, 96 pp., softback with many black & white illustrations. ISBN 1 873580 33 9, £7.99.

During 1989-90, the author, supported by the Vincent Wildlife Trust, surveyed the distribution of this threatened species throughout England, Wales and Scotland. Using a system based on the National Grid, 2,970 pre-selected sites were visited, a camper van being used both as transport and base. A full report has been published elsewhere (Strachan & Jefferies, 1993) and the present volume summarises the findings besides dealing with numerous other aspects of the biology and conservation of water voles.

The presentation is serious but non-technical and there are many, often humorous, sometimes highly artistic, illustrations by the author. The alleged absence of water voles from the Scottish Islands (p. 59) is at odds with the map on p. 51 where Islay is shaded as populated: also there are records from Bute (e.g. Gibson, 1976). Such quibbles apart, this is a delightful little book which constantly displays the author's devotion to his subject. Who else could know that water vole faeces do not taste very nice (p. 22)?

References

Strachan, R. & Jefferies, D. (1993). *The Water Vole in Britain 1989-90: Its Distribution and Changing Status.* The Vincent Wildlife Trust.

Gibson, J.A. (1976). The Freshwater and Terrestrial Fauna of the Clyde Sea Area III. Land Mammals of the Clyde Faunal Area. *Glasgow Naturalist* 19, 259-301.

Ronald M. Dobson

Books received

The following titles were received too late to be reviewed in the present issue. Full reviews will be published in the Glasgow Naturalist for 1999.

Mushrooms and Toadstools
BERNARD DUHEM
Harper Collins, ISBN 0 00 220102, £5.99.
Night Sky
PHILLIPE HENAREJOS
Harper Collins, ISBN 0 00 2201038, £5.99.
Trees of the Countryside
ELIZABETH TROTIGNON
Harper Collins, ISBN 0 00 220101 1, £5.99
Birds in Winter
MARC DUQUET
Harper Collins, ISBN 0 00 220100 3, £5.99.
The Birds of Sutherland
ALAN VITTERY
Colin Baxter Photography, ISBN 1 900455 18 8, £9.95.

ERRATUM

In Gulliver (1997) *Glasgow Naturalist* **23** (2), 55-56: on p.56, paragraph 1, the first sentence should read 'In 1995 all 26 previously known locations of the orchid on Colonsay were visited ....'. Apologies of the editor.

PROCEEDINGS 1997

The Chairman, place*, number present, lecturer's name and title of lecture are given for most meetings.

*BOB Boyd Orr Building
HL Hillhead Library
GKB Graham Kerr Building

14 JANUARY
Norman Tait, BOB, 50, 28th Paisley International Colour Slide Exhibition, Natural History Section, Compiled by members of Paisley Colour Club and presented by W. Brown.

11 FEBRUARY
Norman Tait, BOB, 43, Iain Gibson "Local Bird Recording".

25 FEBRUARY
Norman Tait, BOB, 41, 67th AGM. Reports were presented on activities during 1996, and elections held, resulting in appointments as shown opposite. Membership stands at 252 made up of 209 ordinary, 25 family, 1 junior, 6 school and 11 honorary members. There were 3 Council Meetings and the executive met informally as required.
The AGM was followed by an illustrated talk on the natural history of Lanzarotc give by T.N.Tait.

11 MARCH
Norman Tait, BOB, 63, Helen Cole, "The Alpine Flowers of Ben Lawers".

8 APRIL
Norman Tait, BOB, 39, John Darbyshire, "Badgers".

13 MAY
Norman Tait, BOB, 45, Allan Stirling, "Flora of Ayshire".

7 JUNE
Summer Social, all day visit to Loch Tay area and Crannog led by Dr Jim Dickson. Meal after arranged by H. Rodway. 20 Excursions were arranged for the Summer months.

3 OCTOBER
GKB, Exhibition and Wine and Cheese.

14 OCTOBER
Norman Tait, BOB, 53, Goodfellow Lecture.
Prof. Keith Vickerman, "Tales of Intimacy and Exploitation".

11 NOVEMBER
Norman Tiat, BOB, 61, David Chamberlain "Botanical travels in China".

25 NOVEMBER
Norman Tait, BOB, 31, Members' Slide night, 7 contributors.

9 DECEMBER
Annual Dinner, Ingram Hotel, 54, after dinner talk by Dr J. Macdonald on the Alpine habitat of the "Ice Man".

OFFICERS AND COUNCIL
SESSION LXVII 1997

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Society Events

Some members of the GNHS are shown enjoying the view at St Abbs Head. This was one of three well- supported and successful bus-runs organised by the Society during the summer of 1997.

Microscopes belonging to the GNHS are put to use at a recent Beginners' Tutorial. Dr Wilkie instucts members how to use the microscope as an aid to Lichen identification.

The Glasgow Naturalist

Advice to Contributors

1. The Glasgow Naturalist publishes articles, short notes and book reviews. Book reviews are commissioned by the Librarian, and all books reviewed are kept in the Society's Library. Articles and short notes should be sent to The Editor, Glasgow Naturalist, c/o Natural history Department, Museum and Art Gallery, Kelvingrove, Glasgow G3 8AG. Short notes are edited by Mr A. McG. Stirling. Articles are refereed by the Editorial Board. Final acceptance of articles and short notes is the responsibility of the Editor. The journal is usually issued in May each year. The subject matter of articles and short notes should concern the Natural History of Scotland in all its aspects, including historical treatments of natural historians.

2. Short notes should not normally exceed one page of A4 single-spaced. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references.

Short notes may cover, for example, new stations for a species, rediscoveries of old records, additions to records in the Atlas of the British Flora, unusual dates of flowering, unusual colour forms, ringed birds recovered, weather notes, occurrences known to be rare, interesting localities not usually visited by naturalists, and preliminary observations designed to stimulate more general interest.

3. Articles should be more substantial than short notes, and have no upper limit of length. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. The text should normally be divided into sections with sub-headings such as Introduction, Methods, Acknowledgements, etc.

4. References should be given in full (please do not abbreviate journal titles) according to the following style: Pennie, I.D. (1951). Distribution of Capercaillie in Scotland. Scottish Naturalist 63, 4-17.

Wheeler, A. (1975). Fishes of the World. Ferndale Editions, London.

5. The nomenclature of vascular plants should be as in Stace, C.A. (1991). The new Flora of the British Isles. Oxford University Press, Oxford. Normal rules of zoological nomenclature apply.

6. Submitted manuscripts (two copies) should be typed double-spaced on A4 paper. Once a manuscript has been accepted, typesetting is greatly assisted if the manuscript can be supplied on a microcomputer diskette. Authors are therefore strongly encouraged to produce manuscripts using a wordprocessor (preferably on a PC-compatible microcomputer). However, to assist amateur naturalists, the Editor can make arrangements to have hand-written manuscripts typed.

7. Tables are numbered in arabic numerals e.g. Table 1: they should be double-spaced on separate sheets with a title and short explanatory paragraph underneath.

8. Line drawings and photographs are numbered in sequence in arabic numerals e.g. Fig. 1. If an illustration has more than one part, each should be identified as 9a), (b) etc. The orientation of the figure and name of the first author should be indicated on the back. They should be supplied camera-ready for uniform reduction of one-half on A4 size paper. Line drawings should be drawn and fully labelled in Indian ink, dry-print lettering or laser printed. A metric scale must be inserted in micrographs etc. Legends for illustrations should be typed on a separate sheet. The Editor is able to accept a small number of high quality colour photographs for each issue.

9. Proofs should be returned to the Editor by return of post. Alterations should be kept to the correction of errors. More extensive alterations may be charged to the author.

10. Ten offprints and one complimentary copy of the Journal are provided free of charge. Further copies may be purchased, provided that they are ordered at the time the proofs are returned.

11. All submissions are liable to assessment by the Editor for ethical considerations, and publication may be refused on the recommendation of the Publications Committee.

Acknowledgements

The Editor wishes to thank Patricia Johnston for typing, Liz Denton for re-drawing figures, Norman Tait for preparing the photographs, and Adlard Print and Typesetting Services for their expert printing work.

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Front cover:

Great auk - see short note on the history of the Great auk by T.N.Tait.

Back cover:

Strombus listeri - see paper on Lister's Stromb by Dance and Reilly. Figure 3: *Strombus listeri*, complete shell. Figure 4: Thomas Gray's drawing of *Strombus listeri*.

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Plate 3

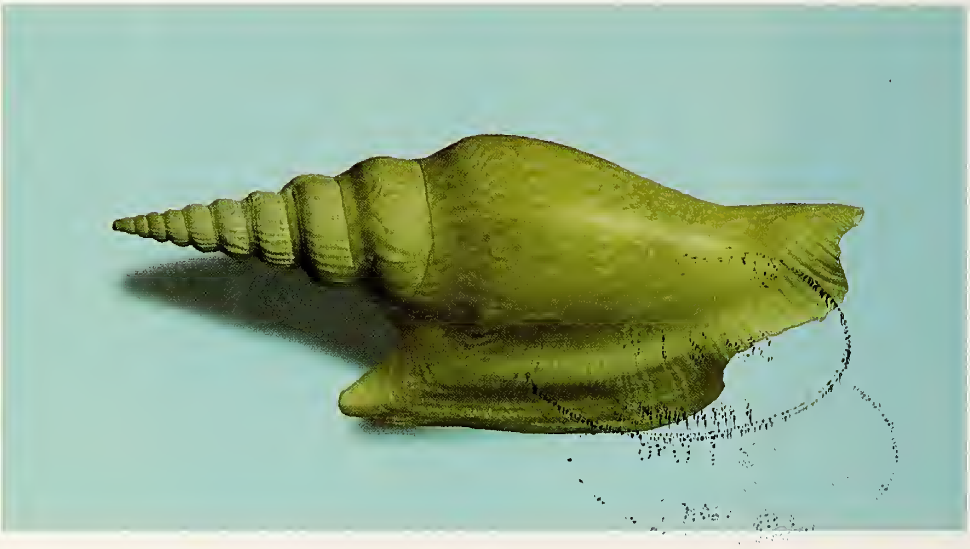

Figure 3 *Strombus listeri,* the complete shell

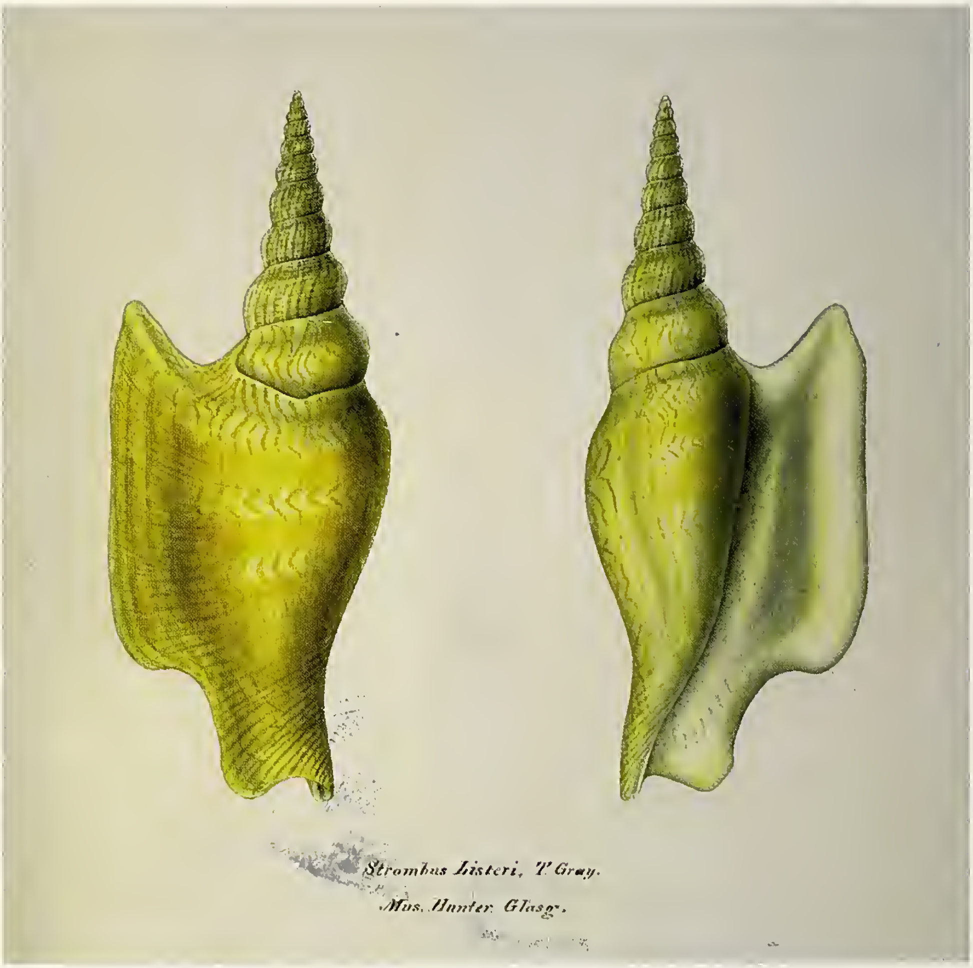
Strombus Listeri, T. Gray.
Mus. Hunter. Glasg.

Figure 4 Thomas Gray's drawing of *Strombus listeri*

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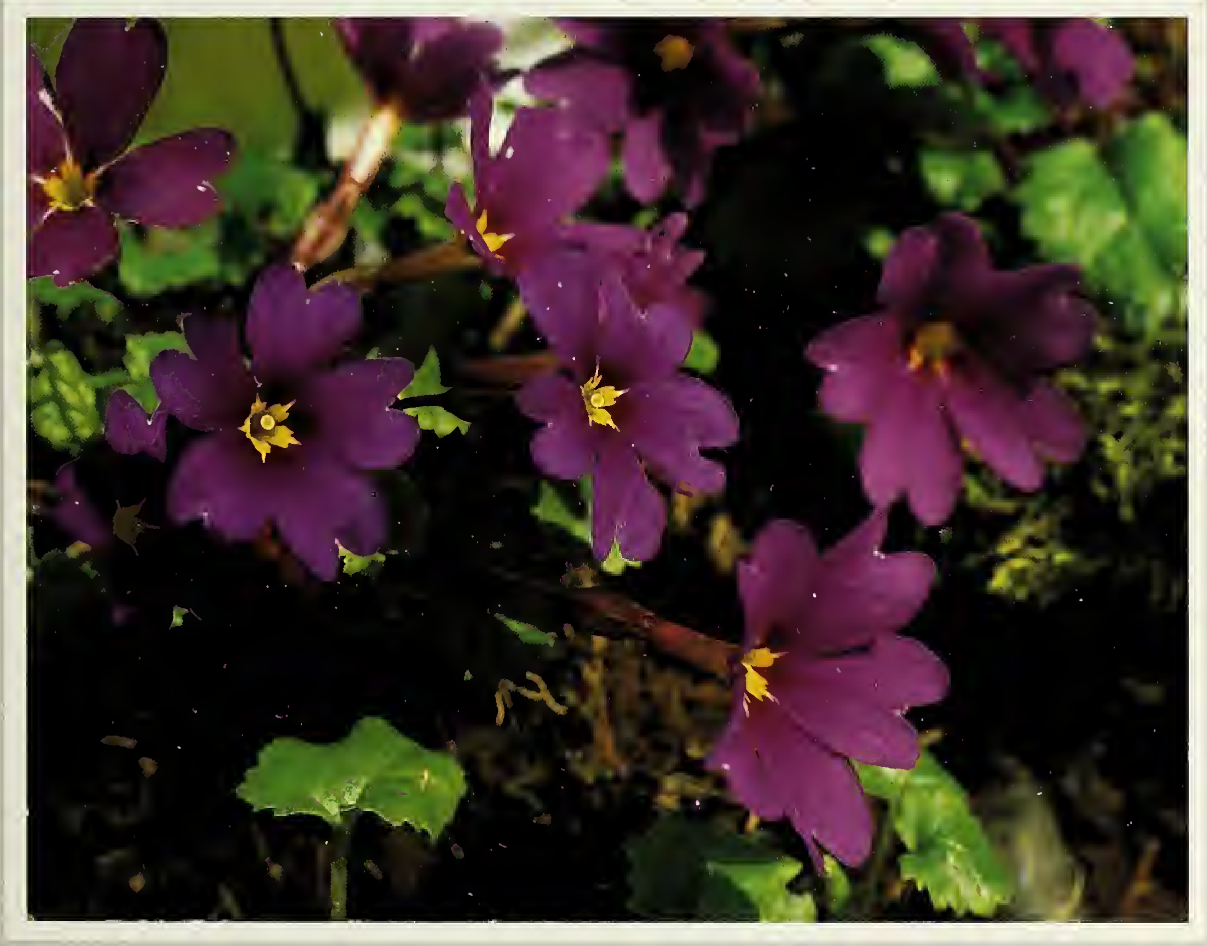
The Glasgow Naturalist



Volume 23

Part 4 1999

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

GLASGOW NATURAL HISTORY SOCIETY

(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow, the Glasgow Art Gallery and Museum, or Hillhead Library.

The present rates of subscription per annum are: for Ordinary Members, £12 (£11 if paid before the A.G.M.): Family Members, £2 extra; Junior Members (under 21), £5; School Members, £1. Payment by Direct Debit is encouraged.

Further information regarding the Society's activities and membership application forms are obtainable from the General Secretary, c/o Natural History Department, Museum & Art Gallery, Kelvingrove, Glasgow G3 8AG.

The Glasgow Naturalist

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Contributions are invited, especially when they bear on the natural history of Scotland. A note of information for contributors is printed on the inside back cover.
A limited number of advertisements can be accepted and enquires should be sent to the Editor.
This publication is included in the abstracting and indexing coverage of the Bioscience Information Service of Biological Abstracts.

The following back numbers are available for purchase in their separate parts:
Vols.II - VII (1890-1918); Vols. XIII - XXIII (1937-1997).
Of the earlier Journals the only parts available are:
Proceedings and Transactions of the Natural History Society of Glasgow Vol. II, pt. 2; Vol. VI, pt. 1; Vol. VII, pt. 3; Vol. VIII, pts. 1 & 2.
Enquiries regarding prices of and orders for any of the above, or for reprints or photocopies, should be addressed to the Librarian:-
Mrs R.H. Dobson, 7 Netherburn Avenue, Glasgow G44 3UF.

Publications of Glasgow Natural History Society

Bound copies of the following may be obtained from the Librarian at the address given on the inside of the back cover and at the prices shown:
The Flora of the Clyde Area (Original printing). J.R. LEE, Price £11.00 to members of GNHS and to the book trade; £13.50 to others (p. & p. £1.00 extra). This is still the only work of its type and is in diminishing supply.
The Flora of Ailsa Craig. B. ZONFRILLO, 1994. Price £2.50 plus p. & p. 25p.
The Vascular Plants of Northern Ardnamurchan (with additions). R.H. DOBSON, 1983. Price £1.00 plus p. & p. 25p.
The Natural History of the Muck Islands, N. Ebudes:

1. Introduction and Vegetation with a List of Vascular Plants. R.H. DOBSON & R.M. DOBSON, 1985. Price £1.00 plus p. & p. 25p.
3. Seabirds and Wildfowl. R.H. DOBSON & R.M. DOBSON, 1986. Price £1.00 plus p. & p. 25p.
5. Landbirds. R.H. DOBSON, 1988. Price £1.00 plus p. & p. 25p.

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GLASGOW NATURALIST Vol. 23 Part 4 pp.1 (1999)

EDITORIAL What is natural history, and what is its modern role?

Two years ago (Downie, 1997) I wrote a commentary, based on correspondence in the journal Conservation Biology, questioning the future of 'natural history' in this country. I hope readers will forgive my returning to this theme: perhaps all the talk of the Millennium bug simply will not allow apocalyptic thoughts to stay away for long. This is also a suitable topic to consider in the bicentenary of the birth of David Douglas, one of Scotland's great natural historians and plant collectors.

My previous article drew on a paper by Reed Noss, editor of Conservation Biology, titled 'The Naturalists are dying off' (Noss, 1996). This year saw the highly distinguished evolutionary biologist and "closet entomologist" (his term), Douglas Futuyma writing "Wherefore and Whither the Naturalist?" in The American Naturalist (Futuyma, 1998).

Noss wrote from the perspective of the practical conservationist; Futuyma is an integrator, a proponent of broad explanatory theories - but his arguments are similar.

As a journal, American Naturalist has metamorphosed from its larval form as a "popular illustrated magazine of natural history" in the late nineteenth century to a journal nowadays "devoted to the conceptual unification of the biological sciences". There is nothing wrong with this change: science thrives on the challenge of competing ideas and the attempt to devise unifying concepts; but, as Futuyma points out, this change of emphasis has accompanied a change in attitude towards natural history. For too many modern biologists, living organisms no longer have interest in themselves: they are regarded, instead, as models to be used for the development and study of general principles and concepts.

I wonder how many readers of this journal regard themselves as scientists as well as naturalists. Futuyma thinks of naturalists as people who love to read about plants and animals, to observe them in the field, to watch natural history films. But the scientific naturalist will take this further, will wish to investigate, to ask questions about plants and animals and to devise testable explanations for their distribution, their abundance, their forms, habits and life histories. It is through this scientific approach that our understanding of living organisms can progress. Some people seem to think that improved understanding reduces our fascination for nature - that a degree of mystery is needed. I think they have little to worry about: most investigations are showing that living organisms are more complex and intricate in their structure and habits than appears on the surface - not less - and that research tends to reveal more mysteries, rather than delivering full understanding.

As Futuyma notes, the biologists of the past who have made the greatest conceptual advances in our understanding of evolution and ecology have been consummate naturalists as well as scientists: Darwin and Wallace, obviously. but also the proponents of the neo-Darwinian synthesis such as Dobzhansky, Mayr, Ford, Ledyard Stebbins and many others. In addition, many of the young people who enter University courses in organismal biology do so as a result of an early fascination for birds, or snakes, or their local flora, or books about dinosaurs: natural history has been their starting point. But when they become researchers, the prestige afforded to models, abstract concepts, and explanatory theories of "life, the universe and everything" lead many to deny their origins and early interests: no ambitious scientist these days wishes to be known for doing 'descriptive' work on a particular group of organisms, rather than testing a 'hot' theoretical concept on a well-chosen 'model'.

Yet this descriptive work is vital. Many of our unifying concepts are based on syntheses of past descriptive studies, and a vast amount of such work remains to be done: Futuyma's example is to note that comprehensive information on host associations of regional faunas of herbivorous insects exists for only one country (Britain) and that useful inter-country comparisons therefore cannot be made. A more basic fact, now drummed into would-be biologists, is that we do not yet know the number of species on earth, even to an order of magnitude. Every biologist could easily add to the list of basic descriptive work needing to be done.

There is, of course, another need - a knowledge of numbers and distribution, so that we can properly assess trends and judge whether suspected species declines are really occurring. We have long-term data for so few organisms. A prominent scare over the last ten years has been the apparent decline in populations of amphibians, reported from many parts of the world. The evidence for this decline is generally convincing, but it has been hard to establish because of the lack of good data on populations in the past.

It is here that the 'ordinary' naturalist can make an invaluable contribution. It takes time, leg-work and many people to establish good records of which plants and animals occur where, and in what numbers. You do not need to be a scientist with deep insights into ecology or evolutionary biology to do such work: you simply need to be able to recognise species, and to have the patience and enthusiasm to go out into the field and record them. This is where Glasgow Natural History Society's work in assembling a computerised database of biological records will be so valuable, as a resource for further study, and management decisions. We must move to a position where our conservation policies, on such issues as which species to target in Glasgow's Biodiversity Action Plan, or whether to re-introduce beavers to Scotland, are based on the best possible information.

In this, naturalist can play a major part. I hope that Glasgow Natural History Society members can see themselves as contributors to this essential effort, and not simply as people who enjoy wildlife: if the effort is not made, there may be little wildlife left for future generations to enjoy.

I hope also that scientific naturalists will shake off any inhibitions they have over declaring their love of and fascination in plants and animals. Douglas Futuyma has 'come out' as an entomologist: E. O .Wilson has never hidden his interest in ants; I am content to be known as a herpetologist. What about the rest of you?

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Downie, J.R. (1997). Are the naturalists dying off? *Glasgow Naturalist* 23 (2), 1.

Futuyma, D.J. (1998). Wherefore and whither the naturalist? *American Naturalist* 151, 1-6.

Noss, R.F. (1996). The naturalists are dying off. *Conservation Biology* 10, 1-3.

GLASGOW NATURALIST Vol.23 Part 4 pp.2-8 (1999)

LOCH LOMONDSIDE DEPICTED AND DESCRIBED
2. EARLY MAPS AND MAP MAKERS

JOHN MITCHELL
22 Muirpark Way, Drymen, Glasgow G63 0DX

"I am told there are people who do not care for maps, and find it hard to believe"
from 'My first book: Treasure Island' Robert Louis Stevenson (1894)

INTRODUCTION

When the founder members of the Natural History Society of Glasgow first gathered together in the Thistle Temperance Hotel in 1851, availability of the first Ordnance Survey maps for the northern Clyde counties was still more than a decade away. Yet by that time, cartography in Scotland already had a long tradition, dating back to when the country was at the north-western edge of the known world. Taking a chronological approach, an overview is presented of some of the milestones in the mapping of Loch Lomond and the surrounding area up to the end of the 19th century. The list of maps included does not claim to be complete, but rather a personal choice based mainly on copies of originals in the author's own map collection for Dunbartonshire and Stirlingshire; and to a much lesser extent, Perthshire and Argyll. Particular emphasis is given to the valuable contributions made to local cartography by the 18th century land surveyors William Edgar and Charles Ross. Locations are given for the unpublished maps. The selected bibliography is largely made up of recommended books on the early mapping of Scotland.

MID 16TH - EARLY 17TH CENTURY MAPS DEPICTING LOCH LOMOND

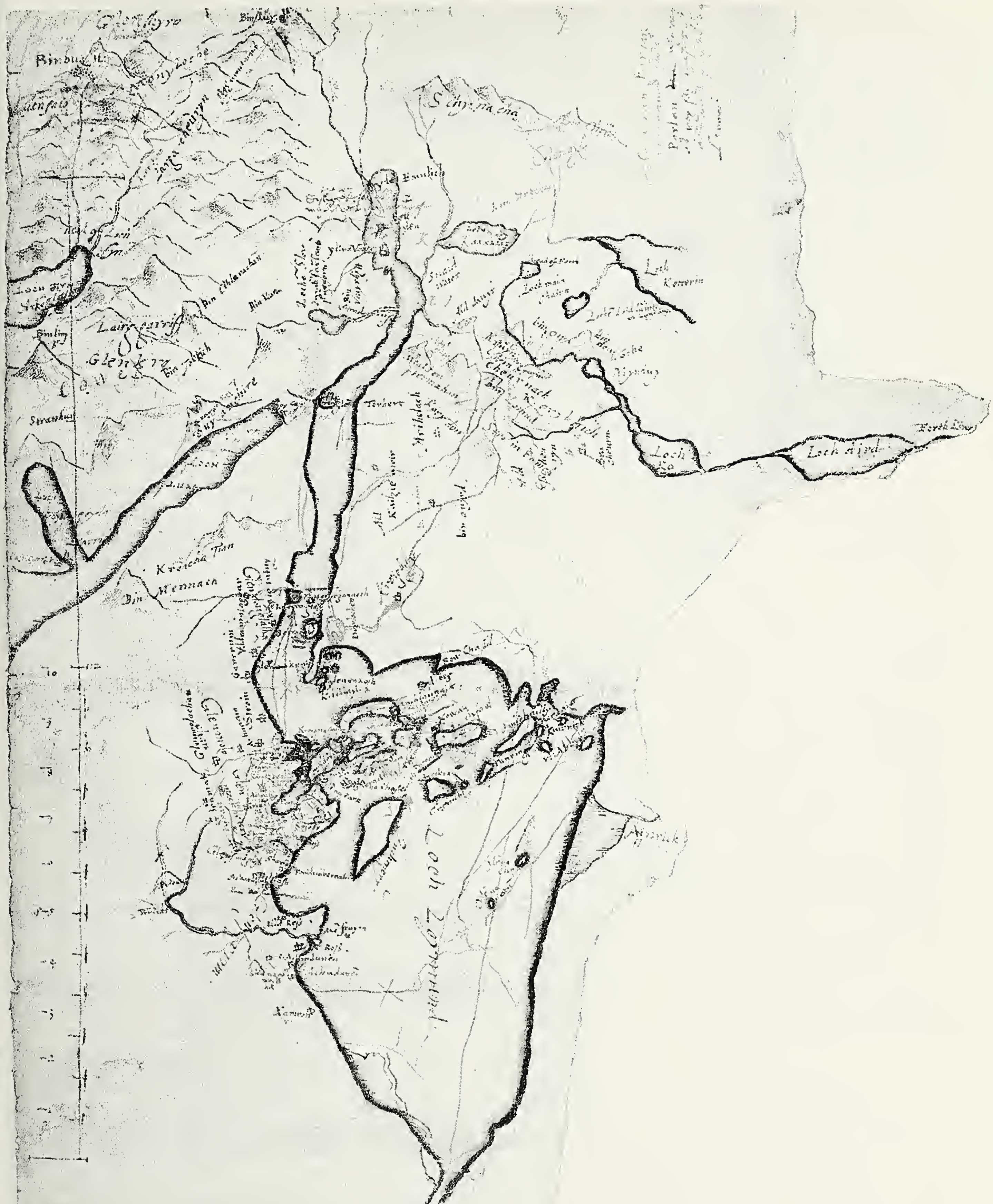
What must be one of the first maps of Britain of sufficient scale to show Loch Lomond is *Britanniae Insvlae ... nova descriptio* 1546, issued by George Lily in Rome, where it is generally assumed that the map was drawn-up from contemporary information gleaned from exiled catholic priests. On Lily's map, Loch Lomond is shown in the shape of a deflating hot air balloon. In *Scotia Regni ... descriptio* 1578, one of the earliest maps of Scotland alone, the same outline of the loch was adopted by another exile in Rome, Queen Mary of Scots' adviser Bishop John Leslie. Plagiarism was common practice in the cartographic world.

The Netherlands and the Rhineland were also centres of map making. Prepared from unknown sources, Gerard Mercator's *Angliae, Scotiae et Hiberniae nova descriptio* 1564 is considered a landmark in the regional cartography of the British Isles. Loch Lomond as depicted by Mercator is difficult to describe - an indented oval shape will have to suffice. Another dutchman, Abraham Ortelius, used the same Loch Lomond outline for *Scotiae Tabula* in the 1573 edition of his *Theatrum Orbis Terrarum.* On the Ortelius map of Scotland, six of the randomly placed islands in the loch are given names for the first time, but none of them are identifiable for certain. Published posthumously in 1597, Gerard Mercator's *Scotia Regnum* was a considerable improvement on his earlier map of 1564, Loch Lomond being portrayed as a more linear-shaped water body. This new, but still far from accurate outline to the loch continued into the next century with John Speed's *Kingdome of Scotland*, in the first ever atlas of the British Isles - *The Theatre of the Empire of Great Britain* - published in 1611.

THE BLAEU ATLAS AND TIMOTHY PONT

The most popular of all the facsimile maps adorning the walls of homes in the Loch Lomond area is *Levinia - the Province of Lennox called the Shyre of Dun-Britton*, reproduced from volume 5 of Joannes Blaeu's *Novus Atlas* published in Holland in 1654. A particularly fine example of the map maker's decorative art, the atlas not only contains three general maps of Scotland, but forty-six individual counties and regions based on the manuscript maps of Timothy Pont, prepared sometime between the years 1583-1596. Pont's work remains the most remarkable feat of topographical sketching of an entire country ever undertaken by one man. Yet a question often asked about the map of *Levinia* is how was it possible that Pont drew the southern-most part of Loch Lomond quite so inaccurately? Fortunately, his manuscript map (Fig. 1) has survived, being currently in the care of the National Library of Scotland. On Pont's original sketch it can be seen that the fine-lined outline to the southern shore of the loch is far more carefully plotted than what eventually appeared on the engraved map well over half a century later. A new outline to Loch Lomond has been superimposed, drawn in an uncharacteristic heavy line which in places obscures the text. So major is the alteration that it is difficult to believe this was done by Pont himself, being far more likely to have been carried out during editing for publication many years after his death. The northern part of Pont's manuscript map of Loch Lomondside was never published.

Fig. 1 (page 3). Late 16th century manuscript map of Loch Lomond by Timothy Pont (by permission of the Trustees of the National Library of Scotland).
Fig. 2 (page 5).Manuscript map of Loch Lomond by William Edgar 1743 (by permission of the British Library).
Fig. 3 (page 7). Engraved map of Loch Lomond by Charles Ross 1777 (by permission of the Bodleian Library, Oxford).


Binbuy
Loch Sloy
Lairg garriff
Glen Kin
Bin Mennaca
Krèicha Tian
Tarbert
Loch Ketterin
Loch Ko
Loch Aird
Forth River
Loch Lomund
Dun Britton

Of additional interest is a set of descriptive notes attributed to Timothy Pont, possibly intended to accompany his map of *Levinia*. Under the title 'Loch Lomund and the Yles therin', forty islands (some of them little more than rock outcrops) are listed, most of the names very similer to those in use today. Fallow Deer *Dama dama* are positively identified as the species kept in the ancient deer park of Inchmurrin; and several other islands are remarked upon for the presence of large number of adders *Vipera berus* (Mitchell, 1907).

The unusual shape of southern Loch Lomond and erroneous placement of the islands as shown on the map of *Levinia* was still being perpetuated by map publishers such as Herman Moll seventy years after the publication of Blaeu's atlas. Moll's depiction of the northern half of Loch Lomondside in his county atlas of Scotland issued in 1725, appears to be little more than guesswork.

Mention too must be made of one of the other Scottish contributions to the Blaeu atlas, a map drawn by Robert Gordon entitled *Scotia Regnum*, in which Loch Lomond is given a strangely squashed-down appearance. Remarkably, outlines of the loch similar to this bizarre shape continued to occasionally appear in publications right up to the beginning of the 19th century.

WILLIAM EDGAR

A positive step forward in the delineation of the loch was made by William Edgar, described by a near contemporary as "a very faithful geographer". Five of Edgar's maps cover various parts of Loch Lomondside, although only one of these was destined to be published - *A New and Correct Map of Stirling-Shire etc.* 1743 (Brit. Lib. K.Top.50.93.1) - and that thirty years after his death in 1746 while in service as a civilian surveyor with the Duke of Cumberland's army. The published version with some updated information appeared under a slightly changed title and date in the Reverend William Nimmo's *General History of Stirlingshire* 1777. Included amongst Edgar's unpublished manuscript maps are: *A Plan of the House, Gardens and Parks of Buchanan, with the lower part of that Barony Ca.* 1745 (Scot.Rec.Off. RHP/6151) - an estate map for the Duke of Montrose; *A New and Correct Map of Perthshire* 1745 (Brit.Lib. K.TOP.50.69) - Loch Lomondside is covered from Inversnaid (Stirlingshire) to the head of Glen Falloch; *The Course of the Kings Road makeing betwixt Dumbarton and Inverary etc.* 1745 (Brit.Lib. K.Top.48.59) - a map for the military, on which is marked an intended bridge to be built over the River Leven at Bonhill.

William Edgar's most important unpublished map in the context of this paper is *A New and Correct Map of Loch Lomund with the Country Circumjacent etc.* 1743 (Brit.Lib. K.Top.48.47) drawn at a scale of approximately one inch to the mile (1:63, 360). To Edgar's credit, Loch Lomond is shown more or less in its correct shape (Fig.2), another first being the inclusion of several major roads.

THE ROY MILITARY MAP

Finding himself without adequate map cover, Lieutenant-Colonel David Watson - commander of the occupying Hanoverian forces in Scotland after the 1745/46 Jacobite uprising - initiated a cartographic survey of the country after peace was restored. With the field note books now lost, the actual date when Loch Lomondside was surveyed is unknown, beyond the fact that it took place between the years 1749-1751.

The survey of Scotland was placed under the supervision of assistant quartermaster William Roy. Like William Edgar before him, Roy was serving with the military while still a civilian, not taking a commission in the army until the end of 1755. Each survey team under Roy's command consisted of an army or civilian engineer, a non-commissioned officer and six soldiers. Using a very basic theodolite and measuring chains, all major roads and water courses were systematically plotted, the intervening countryside generally filled-in by eye. Indeed, Roy himself described the finished work as "a military sketch" rather than an accurate map. The thirty-eight sheets which made up the so-called 'Fair Copy' of the map were drawn at a scale of one inch to a thousand yards (1:36,000). At a later date the sheets were dissected into roughly equal segments, each covering an approximate area of 4 x 7 miles (6.4 x 11.3 kms), then mounted on linen.

Although the Roy map (Brit.Lib. K.Top.XLVIII) was never called upon to meet the threat of further unrest in the Highlands, it was used half a century later as the basis for Aaron Arrowsmith's four-sheet *Map of Scotland* published in 1807.

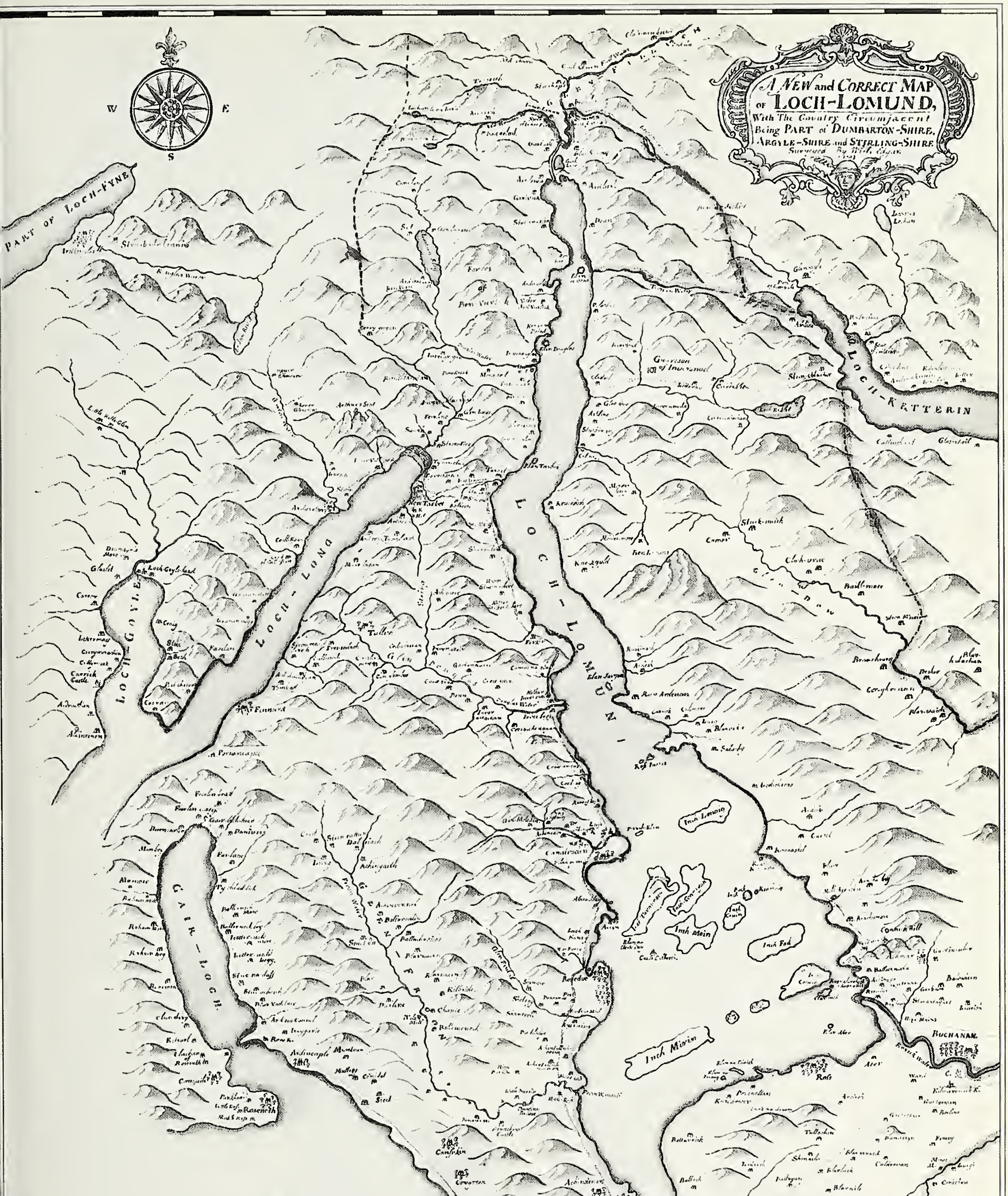
CHARLES ROSS

Land surveyor, architect, travel guide writer and nurseryman, Charles Ross was a man of many parts. Unlike William Edgar, who appears to have been beset with financial problems throughout his short professional life, Ross had the means to get much more of his work engraved and into print; in 1777 producing *A Plan of Loch Lomond* Gough Maps 38, fol.20v (Fig.3), and a two-sheet *Map of the Shire of Dumbarton*, both at one inch to the mile. Ross's outline of Loch Lomond on both maps is by no means an improvement on Edgar's map of thirty-four years earlier, but there were several innovations including a key to the symbols used in the county map. A much reduced version of the Loch Lomond map appeared in his *Traveller's Guide to Loch Lomondside and its Environs* published in 1792, the first ever tourist guide for the area. Seemingly now a rare collector's item, Ross's one inch to the mile *Map of Stirlingshire* was issued in 1780. On both county maps, secondary roads are also shown.

Completing Charles Ross's output of Loch Lomondside maps are his private commissions: *Barony of Buchanan Below the Pass* 1770 (Scot.Rec.Off. RHP/42670) for the Duke of Montrose; *A Plan of the Barronie of Malig with Drumfads etc.* 1776 (Nat.Lib.Scot. MS.ACC.4988) - includes the south-eastern part of Glen Fruin, and a comprehensive *Book of Maps of the Estate of Luss* 1777 (Glas.Univ.Lib. Special Collections Ms.Gen.1006), both for Sir James Colquhoun.

JAMES STOBIE

Although only a small portion of James Stobie's one inch to the mile *The Counties of Perth and Clackmannan* (1783) falls within the Loch Lomond area, the map is worth inclusion



As the Maps of the Shires of Scotland composed by Herman Moll are not only deficient but also vastly erronious in most places particularly in this, where Rob Roys Country is named upon the West Side of Loch-Lomond in that place which the Lands of the Familie of Mcfarlane, and has been so for Many Generations past. Whereas that which was lately Rob Roys only for a few years lyes upon the East Side of that loch, where the Guarison of Inversnaid is now built.

Digital Image Restoration by T. Norman Tait

for its clarity of style. The lower part of Glen Falloch is shown as exceptionally well wooded, a situation that was to change not long after as the stands of Scots Pine *Pinus sylvestris* were sold-off for timber (*Glasgow Courier 3 March 1808*).

JOHN AINSLIE

John Ainslie was one of the most versatile surveyors of the late 18th / early 19th centuries. Apart from his maps of Scotland, his work included town plans and county maps, coastal charts and even a treatise or two on the techniques of surveying. Amongst his prodigious output of estate maps is a *Plan of the Lands of North and South Mains, East and West Gartfairns etc.* 1788 (Private collection, Auchmar House), the survey commissioned by the Duke of Montrose. Like the estate maps of Edgar and Ross, this plan contains a wealth of material for the local historian. John Ainslie's proposed map of Stirlingshire, which would have taken in the larger part of east Loch Lomondside, was never embarked upon through lack of subscribers.

JOHN GRASSOM AND JOHN WOOD

Two new surveys of Stirlingshire and Dunbartonshire - both of which included Loch Lomond - were published within a year of one another. First John Grassom's *County of Stirling* 1817, at a scale of one and a half inches to the mile (1:42, 240), followed by John Wood's half inch to the mile (1:126, 720) *Map of Dunbartonshire* 1818. Although not quite the first to do so for the two counties, both maps showed the new turnpike roads. Wood's map was re-issued in 1823 as a separate sheet to John Thomson's *Atlas of Scotland*, a work not completed until 1832.

THE ORDNANCE SURVEY AND CAPTAIN COLBY

It was William Roy, having risen to the rank of a Major General in the Royal Engineers, who first proposed the triangulation of Britain as the framework on which the next generation of maps would be based, although he died a year before the Ordnance Survey came into existence in 1791. Because of the demands made on the army by foreign wars, the triangulation of Scotland proceeded very slowly. For the Loch Lomond area, progress was made during Captain Thomas Colby's 1815 "season on the hills", when sightings were taken from the Southern Uplands to Ben Lomond - conspicuous at a great distance due to its isolation from the other Lomondside hills. Three years later in August 1818, Colby and his team established a trigonometrical point on the summit of Ben Lomond itself.

Although the primary reason for setting-up the Ordnance Survey by the army was the defence of the realm, Captain Colby quickly appreciated the advantages to be derived from combining accurate Ordnance Survey maps with scientific investigation. In this respect it is worth noting that he held memberships of both geological and natural history societies during his posting to Ireland. Seeing that the old way of life in the Highlands was disappearing for ever, Colby also recognised the etymological value of preserving local place names wherever possible.

A start to the detailed field work, which would lead to the publication of Ordnance Survey maps covering Loch Lomondside, was further delayed until the late 1850s, taking several years to complete. The first Ordnance Survey based map of Loch Lomond was prompted by the paddleship *Prince of Wales* striking a submerged rock off Inchmurrin in September 1860, fortunately without serious injury to the passengers and crew. In the following year, the loch was depth-sounded under the direction of Captain H.C. Otter R.N., the results being combined with the recent coverage of the lochside surrounds by Ordnance Survey officers. The navigation chart *Loch Lomond* (British Admiralty chart no. 2021) was made available to the steamship captains in December 1862.

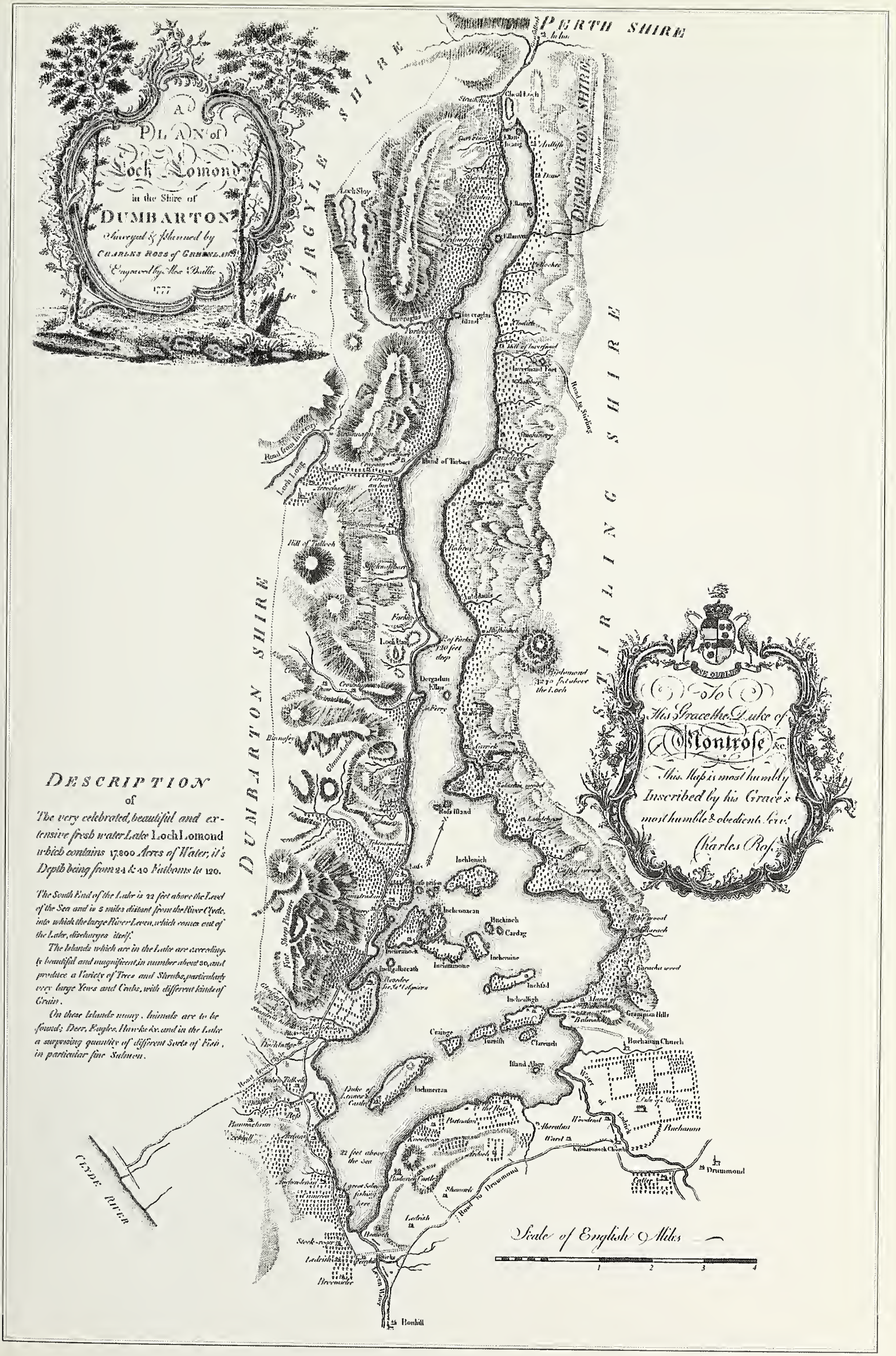
For general use, the first edition of the Ordnance Survey one inch to the mile map covering Loch Lomondside (sheets 30 & 38) was issued between 1866-1868 in plain outline and hachured (relief shading) versions. Larger scale maps were also available.

MAPS USED BY 19TH CENTURY FIELD NATURALISTS

In conclusion to this brief review of early Loch Lomondside maps and their makers, the author was curious to find out which particular maps of the area were favoured by Glasgow naturalists.

One clue was found in the J.A. Harvie Brown papers, which are housed in the Royal Museum of Scotland. In a letter dated April 1868 written by leading ornithologist Robert Gray - one of the founder members of the Natural History Society of Glasgow - he mentions that the county boundaries in the upper part of Loch Lomond had been checked on his Keith Johnston map. Gray is referring here to the engraving and printing firm of W. & A.K. Johnston. Having acquired the rights over the Thompson *Atlas of Scotland* 1832, the individual maps were reissued with the addition of railways under the Johnstons' own name. Both depicting Loch Lomond, *The County of Dumbarton* was published ca.1845 and *The County of Stirling* ca. 1850.

From 1875 onwards, the engraving and printing firm of J. Bartholomew began issuing their 'Half-Inch' reduced Ordnance Survey maps of Scotland, initially published for them by A. & C. Black. For three shillings and sixpence, the field naturalist could for the first time purchase a cased folding map of *Loch Lomond* and *Trossachs District* mounted on cloth for outdoor use. By 1878, Bartholomews had successfully developed contour layer colouring to portray the height of hills, which when introduced was an instant success with the map-buying public. Bartholomews were soon publishing their own 'Half-Inch' reduced Ordnance Survey maps, but their resectioning of Scotland resulted in Loch Lomond and its catchment being spread over four different maps, unlike the first series in which the entire area was covered by a single sheet. However, the retail price of each of these cased cloth-mounted maps in the new series had at least dropped to half-a-crown. There are several of these early Bartholomew 'Half-Inch' maps, which once belonged to the zoologist Hugh Boyd Watt, in the Glasgow Natural History Society's archives.



DESCRIPTION

of

The very celebrated, beautiful and extensive fresh water Lake Loch Lomond *which contains* 17,800 *Acres of Water; it's Depth being from* 24 & 40 *Fathoms to* 120.

The South End of the Lake is 22 feet above the Level of the Sea and is 5 miles distant from the River Clyde, into which the large River Leven, which comes out of the Lake, discharges itself.

The Islands which are in the Lake are exceedingly beautiful and magnificent, in number about 30, and produce a Variety of Trees and Shrubs, particularly very large Yews and Oaks, with different kinds of Grain.

On these Islands many Animals are to be found; Deer, Eagles, Hawks &c. and in the Lake a surprising quantity of different Sorts of Fish, in particular fine Salmon.

Digital Image Restoration by T. Norman Tait

ACKNOWLEDGEMENTS

I would like to take this opportunity of expressing my appreciation to the maps departments of the National Library of Scotland, the British Library, the Bodleian Library of Oxford, the University of Glasgow Library and the Scottish Record Office, for between them making available copies of most of the maps discussed in this paper. The cost of the three illustrations was generously met by a grant from the Professor Lloyd Binns Bequest. I am grateful to Dr. K.J. H. Mackay, for reading through and commenting on a preliminary draft of the paper, and to Norman Tait for his photographic restoration work on the Edgar and Ross maps.

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THE ANIMALS APPEAL TO GOD: A FABLE

LEWIS HUNTINGTON

INTRODUCTION

George Louis Huntington LeBouvier (1921 - 1996; *nom de plume*: Lewis Huntington - Fig. 1) spent seven years as a virological researcher in Glasgow University's Departments of Genetics and of Virology. During this time he manifested and extended his love of the outdoors, of wilderness and living things (except for a few invertebrate "creepy-crawlies"). Our kitchen space was often occupied by edible fungi brought back from his country visits, and we housed the many seedlings he grew: Casuarinas, Scots pines (grown from seeds of a cone from a splendid pine by Loch Morlich; seedling pines were later planted for friends in various sites in Scotland and England), also from fruit pips: grape vines, apples, oranges, lemons and grape-fruit.

In 1970 he left Glasgow to continue his distinguished virological career at Yale University. In 1984 George took early retirement to a series of cabins on a volcanic mountainside in Maui, Hawaii, to enjoy and practice conservation of native birds and flora. He arranged an enclosure to protect natural regeneration of native Koa (*Acacia koa*) trees. He lived his final years in Portland, Oregon, working as volunteer in the Arboretum and the International Rose Test Garden. His death was commemorated in a memorial at the Hoyt Arboretum and by a shrub planted by friends at Haleakala National Park.

A warm, sensitive polymath, musician and poet, his later years were increasingly anguished by human conflicts and suffering and by the impact of our burgeoning species on the world. The Fable below is an unpublished "grown-up" version of one originally written for children, published here with kind permission of his legatee, Geoff Halstead of Los Angeles, California.

Norman Grist,
5A Hyndland Court,
6A Sydenham Road,
Glasgow, G12 9NR

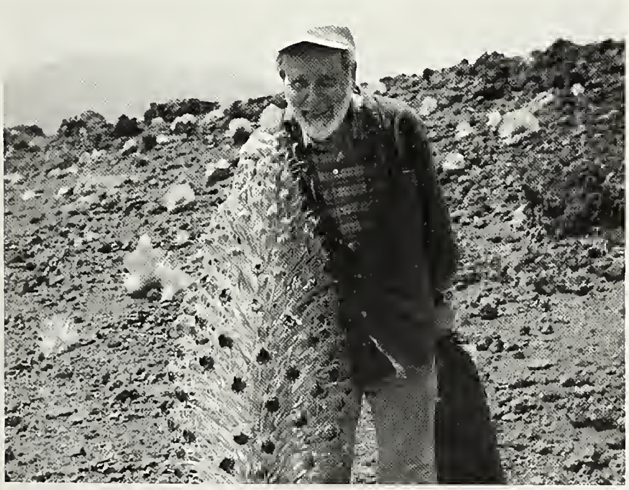

Fig. 1 George Louis Huntington Le Bouvier, with Silverwood (*Argyroxiphium sandwicense*), endemic to Hawaii, in Haleakala crater, Maui, 1987.

THE FABLE

Almost a hundred years ago - a long time for humans and most other living things, but a relatively short span for many trees, and the mere twinkling of a eye for the forces of Earth - a gradual stirring of opinions took place among the world's animals. It was the non-human Primates who initiated this movement; then the Carnivores called a truce, and undertook a fast: the great herds of Herbivores began to congregate and ruminate; the migrating Birds, on their long journeys, carried messages between them all, from South to North, and back again; they told their class-mates of sea and shore, who passed on the word to the Denizens of the deep. In waves across the world, from East to West, the rumours re-echoed in the dawn chorus.

How did such a thing come to pass? One single animal was the cause of all this debate and restlessness: the human species, Man, which had finally grown to be so powerful and ruthless, so greedy, stupid, and arrogant, that it had aroused frustration and rebellion among its fellow-creatures. It had made itself the burning focus for a revolution.

The hearts and impulses of the animals vibrated through space and time, and called on God to harken to their distress. So God commanded them to choose representatives and send them before His throne, one for every species. And they came in their myriads, and rested before Him. And God summoned Man to apear in His presence, and to hear the comments and accusations of his companions upon the face of the Earth.

And God said to the animals: "What is the cause of your bitter dismay? And what is it that you seek?" Then the gentlest of animals, Lamb, was chosen to speak for them all, by way of introduction. He came forward shyly, and began in a hesitant and stammering voice: "O Lord, that Primate whom You did create the last of us all, and to whom you granted a special curiosity and cunning, has now become swollen with pride and limitless ambition. He has used us for his own selfish and short-sighted ends, without thanks, apology, or consideration. Although some of my fellow-animals think he deserves to be eliminated (a fate which he himself often seems to wish to bring about by his own efforts, anyway!), most of us would be content if You could remove him to some other, as yet uninhabited, planet, where he could multiply to his heart's content without restraint, and without any clearly defined mating season (as is his way), and continue his predations, if he must, on his own kind alone, leaving the rest of us in peace. Perhaps, o Lord, You could give him pre-processed minerals for his food, such as digestible oil, silver, and gold; for he appears to dote on these above everything else!"

The Lord smiled to himself at this novel and attractive suggestion concerning materials for sustenance. Then, becoming pensive, he pondered the question long and silently. At length he spoke: "I feel for you, Lamb, my beloved one, and for all your brethren. I have been observing Man's ways, down through the ages, and have become ever more saddened and angered by his vanity, cruelty, and all-consuming greed. I charged him, as well he should know, to be the worthy overlord and wise guardian of the world which you all share with him. I granted him freedom of will, and the faculty of judgement, so that he might deliberately choose the path of wisdom and justice, not only for his own good, but for that of all My creatures whom I have committed to his care. But alas, his power and his cleverness seem to have gotten the better of him and gone to his head .... Even so, in fairness, now that I have listened to your lament and your indictment, are there any among you who may be ready to offer a good word in his defence?"

To this Lamb replied: "Yea, from our impugnments, Lord God, we are moved to exempt most children, and certain people called 'primitive', or 'eccentric', or 'unhinged' by their fellow-humans. For these vanishing individuals and tribes do hold themselves to be guests and pilgrims on this Earth, in company with the rest of us. And they suffer, no less than we, at the hands of those others. To these we can speak, and they to us make answer; for they, indeed, are still in touch with innocence and wonder."

After that, the representatives of the different species began to speak in turn, some reluctantly, or with sorrow, but many in tones of bitterness and resentment. Ox said: "Behold what Man has done! He took me captive, and gelded me, stung me with the goad, and enslaved me under the yoke (even as he has done, and yet does, to so many of his own kind). Or he has fed and fattened me for the slaughter, seeking to appease his insatiable appetites. Or else he condescends to leave me whole and fierce, so that he may taunt me and rouse me to fury, and then kill me, to gratify his repulsive lust for blood. Witness, too, the mountains of skulls belonging to my wild cousin, Bison, driven to the edge of extinction .... Wanton murder, not least of his own race, seems always to have been Man's bitter, searing brand, and shameful hallmark." (Now Fox was heard to murmur: "Hear, hear! It is so devil-smug, with its ritually bloodied face and vicious hands! Enough of this gruesome and cancerous species!")

Then Cat said: "That one has made of me a toy for his diversion. He imagines I must be grateful to him for all his pampering. Sometimes I do humour him; but in general I keep my own counsel, regarding him from a distance, and not seldom with scorn. I never forget my cousins on the broad, bright savannahs and in the dark green jungles, in the cold Siberian snows and on the jagged mountains of Tibet. Drowsing, I see them still ...."

At last, with dignity and grace, Horse said: "He took me from the wild, from my life on the great plains, and broke me to his will. True, he has dealt with me kindly, by and large - though my stepson, Mule, and my patient cousin, Donkey, may judge otherwise .... Yes, even when he sees me as little more than a source of profit, he tends to treat me well; for it intoxicates him to watch me run; and it tickles his pride to be lifted high on my back, fitted with heavy armour or garbed in rich finery. So it makes my heart sad to have to avert my gaze. But I still remember, I still dream of that lost freedom."

And among the Birds of the air, and the Creatures of the deep, many could not find it in their hearts to give utterance to their thoughts. But some, including the Dolphins and the great Whales, were impelled to speak, and said: "Lo, we did sing, for the very joy of being alive! And some of these strange inquisitive beings did truly love and respect us, and enjoyed our singing. But certain of their men of wealth, and thus of their high authorities, decided it would be profitable, and therefore right and proper, to slay us, either directly with guns and nets, or indirectly by poisoning, or by the destruction of our homes (just as they evenhandedly do to certain of their kind). And so, although we feel kindly towards some of its individual members - (could those, perhaps, be sifted out, and kept?) - we cannot, alas, bring ourselves to think well of this overflowing and overbearing species, taken as a whole. It seens to be madly driven into excess in all things."

Then, one after another, the animals spoke, or shook their heads; until the time came for the spokesman of the Dogs to give his opinion. After some grunting, and growling, and clearing of the throat, he delared: "Man - great, gorgeous Man - is the very reason for my existence. He has changed me, at his merest whim, into many different types and forms, so skilfil a magician is he! All that I am I owe to him. He is my Leader, whom I must obey without question. Hail Man! For my part, I think he is entitled to do with us Dogs just as he pleases, since, without him, we would never have become all that we are. So he has my vote." At this, some of the angrier and more hostile animals cried "Traitor!"; and others yelled"Collaborator!", and "Humanist lackey!" They spat on Dog, and turned their backs on him.

But God listened to Dog's statement in silence, and without noticeable surprise. And God thought in His heart: 'Evidently the dog considers that it was not I, but the man, who created him. It is a poor, benighted ignorance; yet it moves Me to compassion'.

Then God turned to Man, and enquired of him what defence he would offer in his own behalf. And Man, looking haughty and aggrieved, said with a loud confidence: "But didn't You Yourself, o Lord Most High, tell me, in so many words, that I should have dominion over all things, and that I should subdue the earth? I took this to indicate that I should knock it into shape, and throw my weight around a bit. (Even so, it's galling not to hold sway over earthquakes, storm and flood! [But say, can I bank on doing so, some day?]) So, anyway, I've just done my thing, regardless, making the most of my position of authority, and - Y'know! - maximising my efforts at total control."

And God sighed .... And He said: "You haven't grasped the true meaning of My words. I intended you to rule as a just, wise, and beneficent steward of all My kingdoms, acting in My Name, more aware of your responsibilities and duties than of your privileges. Among other grave risks and dangers, I warned you against the temptation to serve and worship Mammon; likewise against gross Presumption, and the avid accumulation of evil, corrupting Power, and vulgar Glory. But you have too often risen above yourself, in your conceit; have exploited and abused what was entrusted to your care; and have disturbed the fine balance of My good creation. Can you honestly have believed that I meant you to carry things to that extreme?"

And God turned towards the assembled animals, and said: "I have heard your various accusations and complaints; and I find that Man has indeed done you wrong, for the most part unintentionally, but at times with malice aforethought. For this he shall be held accountable. However, I have also been touched by Dog's unwavering devotion. Man may not always have deserved such love. But I will weigh it in the scale in his favour. For I am loth to undo in haste this creature that was to have been the crown of My labours on this particular planet .... Hear, therefore, what I intend! If there be but one other living thing upon the surface of Earth that will see fit to put in a good word for the progeny of Adam, I will stay My hand and reserve judgement, while I wait to see what further changes shall come to pass ...."

Silence descended upon the assembly: a vast silence unfolded and unrolled itself in the mansions and gardens of Heaven .... Was there not one other voice to speak up for this self-infatuated, yet self-savaging, Primate, this creature spoilt, bloated, violent, dirty and loud? None to extenuate its bigotry, hypocrisy, and greedy, frivolous myopia?

At last, from the back of the huge gathering there came a thin, high-pitched, querulous humming - at first tentative and remote, but gaining in strength and sibilance as it approached. " Hmmm, hm-hmmm, hm-hm-hmmm! I wasn't altogether sure if he was worth it; but, on the whole, well ye-e-es, I suppose I can just about manage to tender a hesitant, and rather unenthusiastic, vote on behalf of that monstrous human lump from which I like to sip warm blood. He doesn't exactly make me welcome, let me tell you! In fact, he usually tries to squash me, and occasionally succeeds! All the same, he does come in pretty useful from time to time, especially when I'm preparing to unload the wee egglets of my precious, wriggling brood into the welcoming waters.

But mind you, the favour is not all one-sided, by any manner of means: with the vital co-operation of my little parasites and viruses, I help to moderate and control his painfully exploding numbers; and this, I'm sure, must be of tremendous benefit all round ... (As you will probably have gathered, by now, I am the female of my species - one of the very few that have been appointed to speak in this quite depressingly male-dominated congress!)" And she unfurled a banner proclaiming: Vivent les différences! Vive le chromosome X!

"Hmm, aye: Mrs A MacUlipennis, is it not? .... Well there it is!" said the Lord God. "As Mistress Mosquito has now cast that one additional vote in his behalf, We are prepared, albeit with a measure of dubiety and misgiving, to grant Man yet one more period of probation - on top of those countless others that he has already received in the past (all the way from Noah on down). He shall have the coming century during which he must do all that he can to get his act together, one hundred years for him to learn to mend his ways, and to demonstrate to Us beyond a doubt that he has, at long last, decided to follow the sensible course of compassion, and good humour, of moderation, humility, and wisdom. We believe he has it in him, if only he will put his mind to it!"

And turning to Man, thus God warned him: "And pray do not presume to say to yourself: 'Oh, I'll manage to get away with it, no question about it ... The soft-hearted Old Parent would never dream of transferring or terminating me! I'll muddle through all right, and emerge unscathed; the way I see it, I'm indispensable; for I'm essential to His cosmic plan ...' When you feel a tendency to indulge in such vain and complacent thoughts, just remember that a stern possibility looms ahead: the time may well arrive - we say it with sorrow, o special and highly favoured child - when you will find that you have committed yourself, by your own stubborn choice, to an outcome beyond reversal or reprieve ..." And God addressed the assembly of all the animals, and said: "And so, when the years roll round - mark well these Our words! - We shall summon all of you hither, once again. And we shall review the case, and determine how these grave matters then do stand. The court is now pro tempore adjourned ... children, go all of you your several ways in peace!"

EPILOGUE

And now, in our present days,
Those one hundred years of grace
Have well-nigh run their course!
The animals bate their breath -
And look to the All-One:
A judgment-time impends
For the truant species, Man;
His tyranny - wild, rash, unaccountable - ends ...

CAUTIONARY APPENDIX Have fun picking out the manifest (or apparent) Anachronisms! But be mindful that the Animals may have greater Foreknowledge, and Insight, and Dream-Elucidating Skills than do we mere members of the autocentric species *Homo (tantum) sapiens*! For instance, who's to say that Mrs Ann-Ophelia MacU. was not already well aware of her malaria parasites and assorted encephalitis viruses, back in 1899? Or that the Whales and the Dolphins couldn't already foresee the days of communication with humankind?

GLASGOW NATURALIST Vol. 23 Part 4 pp.12-18 plus Plate 1 (1999)

WOUND-HEALING AND VEGETATIVE REGENERATION OF TREES IN THE WEST OF SCOTLAND

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INTRODUCTION

The protective bark of a tree often becomes damaged by lightning strike, by browsing deer or other animals, when branches are broken off in a storm, and during pruning or felling. As a result the parenchyma and other living cells at the injured surface are killed and then become impregated with suberin which renders them impermeable. The damage also usually exposes the water-conducting tracheary elements in the xylem (sapwood), whose lumens become plugged by gum (Smith, 1986). This initial response to injury occurs rapidly and helps to protect the newly exposed surface from desiccation and microbial infection (Hartmann, Kester and Davies, 1997).

Subsequently, depending on favourable environmental influences as well as endogenous factors, the uninjured living cells adjacent to the wounded surface begin to divide and typically give rise to a parenchymatous callus (Bowes, 1999). A new cork cambium develops later near the surface of the callus and this is followed by the formation of a vascular cambium internally (Sharples and Gunnery, 1933; Hartmann, Kester and Davies, 1997).

In many instances the response of plants to physical trauma is not confined to wound-healing and new roots and shoots may also develop (Sidwell, 1996; Smith, 1986), but sometimes these new organs arise remote from the wound. The following account discusses some typical examples of wound-healing and vegetative regeneration observed in seven temperate hard-wood and three soft-wood species of trees (both indigenous and non-indigenous) growing in the West of Scotland. These observations are illustrated by a number of photographs: details are given in the Figure legends of the location of the specimens and the dates they were examined.

OBSERVATIONS AND DISCUSSION

Wound-healing in trees

Fig. 1A shows the main trunk of a sessile oak tree (Quercus petraea, growing near Rowardennan) which has been severely injured by the stripping of its bark (periderm) and the exposure of a patch of the underlying wood, measuring approximately 35x18 cm. Over part of the wood an irregular patch of nodular

Figure Legends (for Fig 1, p13)

Fig. 1A-B. Wound caused by bark stripping of the trunk of a sessile oak (*Quercus petraea*). The wound (1A) measures approx. 35x18cm and a ridge of wound cork has formed on its left and right margins, whilst at the lower right nodular callus occurs over part of the exposed wood. 1B demonstrates that callus is initiated in relation to the medullary rays and in tangential (surface) view of the xylem these appear as very narrow and vertically elongate structures (magn. approx. 0.9). Photographed 2/2/96 on east shore of Loch Lomond by North Highland Way and about 1.5km north of Rowardennan.

Fig. 1C. Trunk of a horsechestnut (*Aesculus hippocastanum*) showing a partly healed scar of a small branch (top) and a fully healed scar (bottom). In the former, the cross face of the wood exposed in the centre of the scar is surrounded by a prominent circular ridge of wound cork. Photographed 19/2/96 just north of Mugdock Loch by track leading to Craigend Castle.

Fig. 1D. Fully-healed scar of a large branch on the trunk of a beech (*Fagus sylvatica*): the depression in the middle of the scar shows where closure occurred. Photographed 3/3/98 in woodland on east side of Mugdock Reservoir.

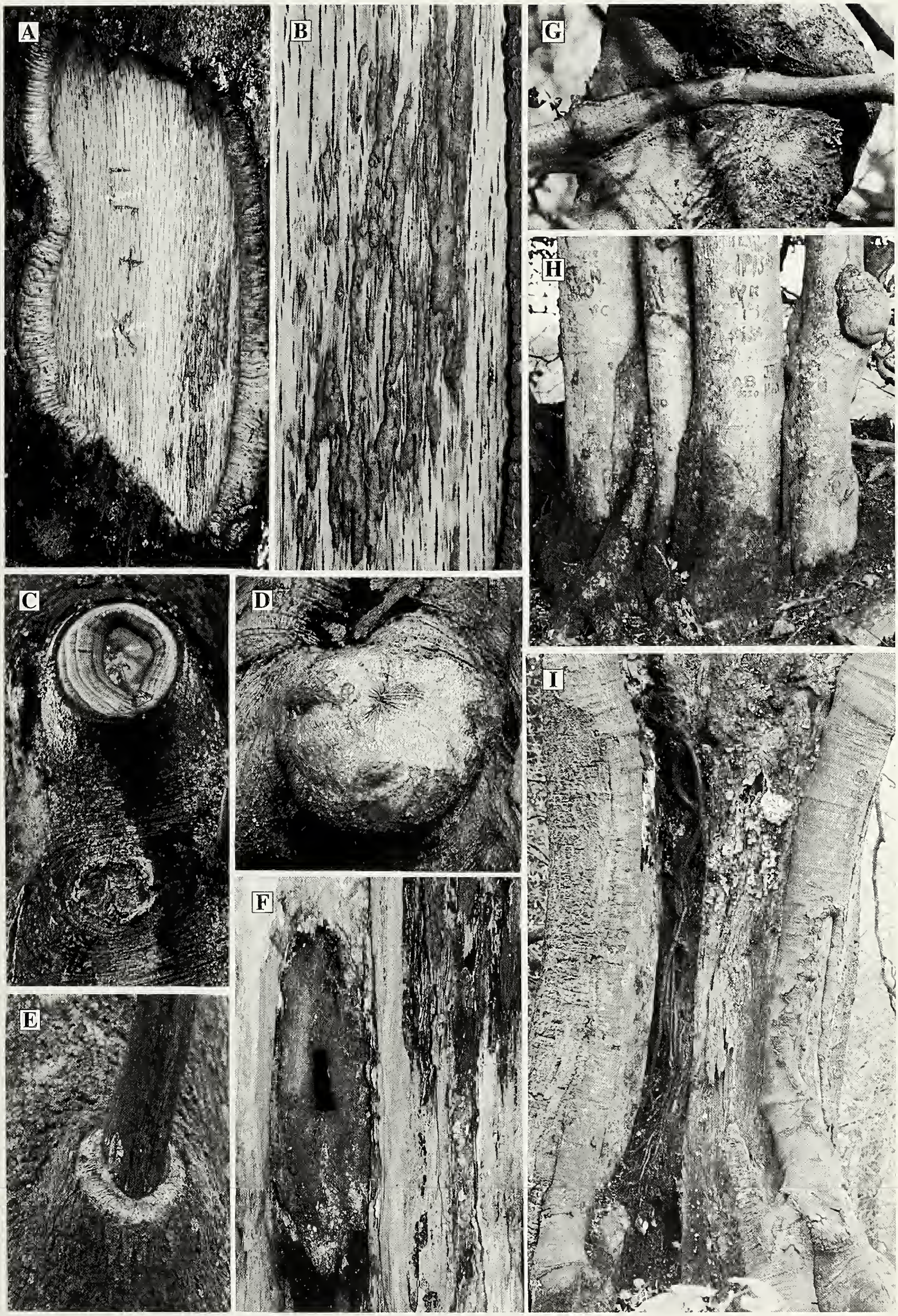
Fig. 1E. Trunk of sessile oak (*Quercus petraea*) showing the dead wooden core of a side branch with a ridge of wound cork at its origin from the trunk. Photographed 26/2/96 in north east of Mugdock Wood.

Fig. 1F. View of the inside of a hollow beech pollard (*Fagus sylvatica*) showing an elongated patch of wound cork covering the inner (rotted) surface of the hollow wooden core. The cork represents the inner extension of an incompletely healed branch scar. The cork is continuous, via the elongate hole at the centre, with the bark on the outside of the tree trunk. Photographed 19/4/96 in beechwood just north of Callandar Golf Course and west of Bracklinn Falls.

Fig. 1G. Natural grafting in beech (*Fagus sylvatica*) between a small lateral side branch and a larger trunk (approx. 25 cm in diameter) of the same tree. Photographed 19/2/96 at eastern edge of Mugdock Loch.

Fig. 1H. Part of the beech "hedge" (*Fagus sylvatica*) at Meikleour, which was planted in the mid-18th Century. The area illustrated shows the trunks of several individual beech trees which have grafted laterally due to their growth close together. Photographed 16/2/96 from western side of "hedge" at Meikleour, Perthshire.

Fig. 1I. Bole of a beech pollard (*Fagus sylvatica*) which has split open to reveal its rotten, hollow centre. At about 1.8m above ground level a number of adventitious roots have arisen from wound cork and grown downwards into the soil at the base of the tree. Note also the prominent lateral ridges of wound cork. Photographed 17/12/95 in woodland by Pollok House.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callus has developed and Plate 1B shows this area in more detail. The narrow, vertically orientated structures (Fig. 1B) represent medullary rays, as seen in tangential view, and evidently the callus has developed from their constituent cells. This was also described for wounded xylem in *Hibiscus rosa-sinensis* and Hevea brasilensis (rubber) by Sharples and Gunnery (1933). In another tropical species (*Adansonia digitata*), when 16-21 year-old branches of this sap-wood tree are cut across, callus is produced (from the pith and axial parenchyma as well as the medullary rays) over the entire surfaces of the stumps remaining on the tree (Ng, 1986).

Although, typically, callus is initially composed of unorganised parenchyma (Bowes, 1999), differentiation of other tissues soon occurs. On examination of this oak callus (Fig. 1B) in sectioned material, scattered groups of tracheary elements were identified within the parenchymatous ground tissue, whilst an irregular cambial-like tract of cells, probably the beginning of a cork cambium, was also present. When the wounded oak was first examined in 1996 (Fig. 1A) it seemed very unlikely that the callus would develop further. And in fact, when the specimen was re-examined and photographed in 1999, careful comparison of the original and later photographs showed that the wound callus was apparently unchanged in its distribution or thickness during the three year interval between these observations.

On the two vertical edges of the wound, semi-cylindrical ridges of wound cork are present (Fig. 1A). These presumably develop in a somewhat similar manner to the wound cork described by Sharples and Gunnery (1933) in two tropical species. Nevertheless, there are clear differences between wound-healing in the sessile oak and that in *Hibiscus and Hevea*. In the latter examples, narrow strips of bark about 13mm wide were experimentally excised in comparison to a wound about 180mm wide in the oak. The wounds in Hibiscus and *Hevea* were enclosed with waxed tape to prevent desiccation and maintain a humid atmosphere and healing proceeded rapidly in the tropical warmth of Malaysia. At the wound surfaces, callus formed uniformly over all the exposed xylem and differentiation of cork and vascular cambia then occurred centripetally across the callus in continuity with the cambia of the unwounded stems. Thus the wounds became closed by a new layer of cork, whilst internally, secondary vascular development resumed, and in *Hibiscus* within two months the wound was completely healed.

However, in *Quercus petraea* the wounded surface was not maintained in a humid environment and the low winter temperatures (which inhibit cell division) of a Scottish winter have limited the development and subsequent survival of the callus. Consequently callus formation has not occurred rapidly across the exposed surface of the wood but, apart from the limited production of nodular callus from the medullary rays, instead has been confined to its margins. Comparison of the extent and distribution of the wound cork in 1996 (Fig. 1A) and in 1999 shows that during this three-year period each vertical ridge of wound cork has grown centripetally by about 9-13mm, whilst a new ridge of cork has also developed along the lower margin of the wound.

One of the most commonly observed wounding responses in trees is the healing of branch scars and Fig. 1C (top) shows the partly closed scar on a horse chestnut (*Aesculus hippocastanum*) growing in Mugdock. The branch arose from the main trunk at about 3 metres above ground level and was approximately 14cm in diameter. The original cut has left intact the collar underlying the branch, as in the Shigo pruning method described by Mitchell (1997). Beneath the partly closed scar lies a fully healed scar of a branch pruned several years previously and in which, due to the expansion of the tree with secondary thickening, the scar lies more-or-less flush with the trunk.

In the centre of the top scar (Fig. 1C), the sawn off cross-face of the wooden core of the branch is surrounded by a wide circular ridge of wound cork. This ridge itself shows subdivision into several concentric rings, which may reflect a periodicity in the growth of the callus: partially healed branch scars of the same appearance occur on several adjacent horse chestnuts. On the margins of the scar the cut transverse face of the original bark is still distinct from the lighter coloured wound cork. At a later stage the two tissues will merge and become more-or-less indistinguishable, as in the lower healed scar. The visible cut wood surface (approximately 6x8cm in width) of the branch shows no evidence of decay and later the wound callus is destined to cover its complete surface. This is a slow process since, three years after Fig. 1C was photographed and despite centripetal increase of about 1.5-2cm to the inner rim of the wound cork, the cut (wood) face of the branch was still clearly visible and about 3.5x4cm in width.

In many situations branch scars eventually heal completely (Fig. 1C, lower scar). This is also illustrated in Fig. 1D for a naturally pruned beech (*Fagus sylvatica*), growing in woodland at Mugdock Reservoir, where the slight depression in the centre of the scar indicates the point of its closure. This is an example of natural or self-pruning (cladoptosis) which is also frequently evident in a number of other hardwoods and also conifers (Smith, 1986). Where this occurs the abscission zone develops at the base of the branch (Bell, 1991), and internal to its separation layer a thin layer of cork develops prior to abscission. Sometimes, however, wounds do not heal completely as is the case when a branch dies but leaves a persistent decayed core (Smith, 1986; Bell, 1991). This is illustrated in Fig. 1E in a sessile oak (*Quercus petraea*) from Mugdock where the dead wood has prevented the further development of the encircling ring of wound cork at the branch base. Further healing cannot occur unless the dead branch snaps off, and so long as it protrudes, it provides a possible pathway for microbial infection.

Fig. 1F shows an internal extension of a partly healed branch scar, situated about 1.5m above soil level, visible on the inside of a split open hollow beech pollard growing near Callandar. An elongated patch of wound cork has grown outwards from the central elongate hole to cover a small area of the inner face of the hollow cylinder of wood. This cork is continuous, via the hole in its centre, with the bark on the outside of the bole and externally it is obvious that the hole represents the centre of an imperfectly healed branch scar. It is possible that this wound provided an entry point for the fungal infection (Rayner, 1996) which rotted the original heartwood of the pollard.

Another situation where the wounding reaction occurs is in the grafting of tree parts. This commonly occurs in ivy (*Hedera helix*) stems and the anatomical events in this process were described by Milner (1932). Grafted branches have been frequently observed in old specimens of beech (*Fagus sylvatica*, Bowes 1996a) and in several sycamore trees (*Acer pseudoplatanus*) growing at Mugdock. Fig. 1G shows a small branch of a beech growing at Mugdock; this is firmly wedged across a trunk (about 25cm in diameter) from the same tree and has become deeply embedded in it. Their subsequent combined growth will eventually lead to the complete fusion of these stems. Fig. 1H illustrates part of the beech "hedge" at Meikleour where the saplings were planted in the mid 18th Century in a row over 500m long. Due to growth in close proximity, grafting has frequently occurred between neighbouring tree trunks.

Because of the stability the root system of a tree normally enjoys when surrounded by soil, grafting is very common in the roots of many arborescent species (Smith, 1986; Packham et al, 1992). This can be noted in the root systems of a number of oaks (*Quercus petraea*) growing on the flood eroded east shore of Loch Lomond at Rowardennan and is also commonly visible in the surface roots of beech (Bowes, 1996b) and other trees.

Rooting on old tree trunks

The examples of the healing reaction in trees previously discussed have been confined to wound healing, but root regeneration is frequently a concomitant of wounding. Fig. 1I shows part of the hollow bole of a beech tree (*Fagus sylvatica*) growing in Pollok Park. On either side of the split open bole, vertical ridges of wound bark merge laterally with the undamaged bark whilst, at about 1.8m above ground level, a number of adventitious roots have arisen from a patch of wound bark. These roots are up to 3cm wide at their origin but become thinner lower down the bole and have grown into the soil at its base. Fig. 2A shows detail of similarly formed roots (also demonstrating natural fusion) in the hollow bole of another beech growing near Callandar. A number of other rooted beech specimens have been noted in the Garscube Estate, Glasgow Botanic Gardens and in a beechwood near Callander. A few old beeches show layering of their lower branches, as in the strange-looking specimen growing on the mound in the garden of Pollok House. In some cases such branches have rooted and Mitchell (1996) records that at Newbattle Abbey near Dalkeith, the layered branches of an ancient beech trunk (now decayed away) have rooted and developed into a number of upright trunks up to 2.7m in circumference. In Fig. 2B a Japanese cedar (*Cryptomeria japonica, growing* at Kilmun near Dunoon) exhibits numerous prominent pap-like structures, extending up the trunk for some 4-5m above ground level. These are interpreted as the initials of adventitious roots but there was no apparent injury to this tree, apart from some lopping of branches. It was the only individual, in a stand of about twenty 60 year-old specimens, showing these primordia and their occurrence may perhaps be genetically determined. Fig. 2C illustrates the upper trunk of a partially hollow common alder tree (*Alnus glutinosa*) growing by the Allander in Milngavie: the central wider root originates from higher up the trunk but the group of thinner roots (left) appear to have formed from wound callus. Similar root development from the trunks of mature trees has been also observed by the author in *Carpinus betulus* (hornbeam), *Salix* (willow), *Sequoiadendron giganteum* (Giant Sequoia), *Sorbus aucuparia* (rowan), and *Taxus baccata* (yew) at various sites in Britain. This rooting response of mature temperate trees does not appear to have been described previously but is, however, well-known in the banyan tree *(Ficus benjamina)* and other tropical trees (Bell, 1991; Menninger, 1995).

Adventitious shoots on tree trunks and branches

In addition to roots, numerous tree species regenerate shoots: several buds, some already sprouted, are visible on the lower trunk of the common lime tree (*Tilia x europeae*, Fig. 2D) growing in Glasgow Botanic Gardens. Such epicormic buds develop on the trunks of many species (Bell, 1991), even when the tree is apparently uninjured, and often arise from dormant, deeply buried axillary buds. If a common lime tree is left undisturbed, it frequently develops dense and unsightly clusters of twigs on the lower trunk (Bowes, 1999). However, in parks and gardens the twigs are usually removed from the trunk, but require yearly retrimming to remove further buds sprouting from their base (Fig. 2D).

Injury to trees due to felling, pollarding or coppicing frequently provokes the growth of new shoots (Smith, 1986; Rackham, 1989; Sidwell, 1996). These shoots develop either from pre-existing buds (as in common lime, Fig. 2D), or from buds which form adventitiously. On the felled stump of the poplar tree (*Populus*, Fig. 2E) by the Kelvin Way in Glasgow, bud primordia have formed de novo from the callus which has proliferated from the cut surfaces of the cork and vascular cambia. When regeneration occurs profusely, as in the pollarded horsechestnut (*Aesculus hippocastanum*, Figs. 2F-G) growing at Mugdock, it is not always possible to distinguish those shoots arising on the callused surface from those formed from the undamaged bark beneath the cut. In the latter case it is uncertain whether the buds are formed de novo by dedifferentiation from the cork cambium or arise from pre-existing but dormant buds (Fig. 2D).

Although prolific adventitious regeneration may initially occur (Figs. 2E-G), typically several of the new shoots later became dominant. This is shown in a seven year-old sycamore (*Acer pseudoplatanus*, Fig. 3A) coppice, with branches up to 8 cm in diameter, growing near Thornhill. When a coppice is left uncut over many years it may form several large trunks and the ancient yew *(Taxus baccata)* coppice shown in Fig. 3B has 9-10 large trunks arising from a stool about 1.5m wide. This specimen was one of the population of yews described by Mitchell (1972) from Inchlonaig in Loch Lomond. Another old and untended coppice is evident in an oak (*Quercus petraea*, Fig. 3C) growing in Retreat Wood, Galloway. In a pollard, the initial profusion of new shoots at the excised surface (Figs. 2F-G) becomes greatly reduced in the mature tree. Fig. 3D shows an old sycamore *(Acer pseudoplatanus)* pollard growing at Mugdock, with several very thick branches arising from the bole at about 2.3m above ground level.

Shoots arising from tree roots

In addition to the regeneration of shoots from wounded tree trunks and branches a number of species (Burrows, 1990; Bell, 1991; Bowes, 1999; Packham et al, 1992) are capable of developing buds from the vascular cambium or pericycle of the roots. Fig. 3D illustrates a portion of a long superficial root which was attached to the stump of the poplar *(Populus)* tree previously discussed in relation to Fig. 2E. This root bore several leafy buds which developed following the felling of the tree trunk. In most species of elm *(Ulmus)*, suckers arising on the roots of an individual tree develop into a clone of new trees (Rackham, 1989).

The coastal redwood *(Sequoia sempervirens)* also regenerates from its roots and often, in its native Californian habitat, as many as 100 young sprouts surround an established tree or felled stump. This pattern of regeneration results in the circular groves characteristic of the species (Hewes, 1981). The coastal redwood was introduced to Scotland in the middle of the 19th Century and some well-established trees (Mitchell, 1996) are now growing here, as illustrated (Fig. 3E) in a small redwood grove growing at Benmore, near Dunoon.

Figure Legends (for Fig 2, p17 and Fig 3, centre page)

Fig. 2A. Detail of the adventitious roots in the hollow bole of another beech pollard *(Fagus sylvatica)*. Note the several anastomoses between the roots. Photographed 19/4/96 in beechwood just north of Callander Golf Course and west of Bracklinn Falls.

Fig. 2B. Trunk of a 60 year-old Japanese cedar *(Cryptomeria japonica)* showing numerous pap-like protruberances which are interpreted as adventitious root initials. Photographed 23/2/96 in Forestry Commission Arboretum at Kilmun near Dunoon.

Fig. 2C. Hollow trunk of an alder tree *(Alnus glutinosa)* showing a number of thin adventitious roots (left), which have a common origin from wound cork at their base, and a thick root running down the hollow centre from higher up the trunk. Photographed 8/12/95 on east bank of Allander at northern end of Allander Park, Milngavie.

Fig. 2D. Part of the trunk of a lime tree *(Tilia x europeae)* showing a number of leafy buds. Some of these have arisen from axillaries on the stumps of previously pruned twigs, whilst others appear to have arisen from the bark. Photographed 23/5/96 in Glasgow Botanic Gardens Arboretum.

Fig. 2E. Part of a stump of a poplar tree *(Populus)* cut across at ground level. Note the presence of a number of leafy buds in the area adjacent to the wood whilst bud initials are also visible in the peripheral callused area of the bark. Adjacent to the gravel (bottom) a large leafy bud appears to have developed from the outer surface of the bark. Photographed 24/5/95 at side of Kelvin Walkway near Kelvin Bridge, Glasgow.

Fig. 2F. Side trunk of a horsechestnut *(Aesculus hippocastanum)* showing the profuse development of twigs at the top of the pollard. Photographed 1/3/96 just north of Mugdock Loch by track leading to Craigend Castle.

Fig. 2G. Pollarded tip of another horsechestnut *(Aesculus hippocastanum)* trunk. Some twigs appear to have arisen from the intact bark just beneath the cut surface but most have formed from the callused vascular cambium. Photographed 7/12/98 just north of Mugdock Loch by track leading to Craigend Castle.

(Figure 3A-F, Plate 1, centre pages)
Fig. 3A. Young branches of sycamore *(Acer pseudoplatanus)* which have arisen after the old coppice stool (hidden under the grass) was vigorously recut seven years previously. Photographed 6/11/95 at a Scottish Conservation Projects site near Thornhill.

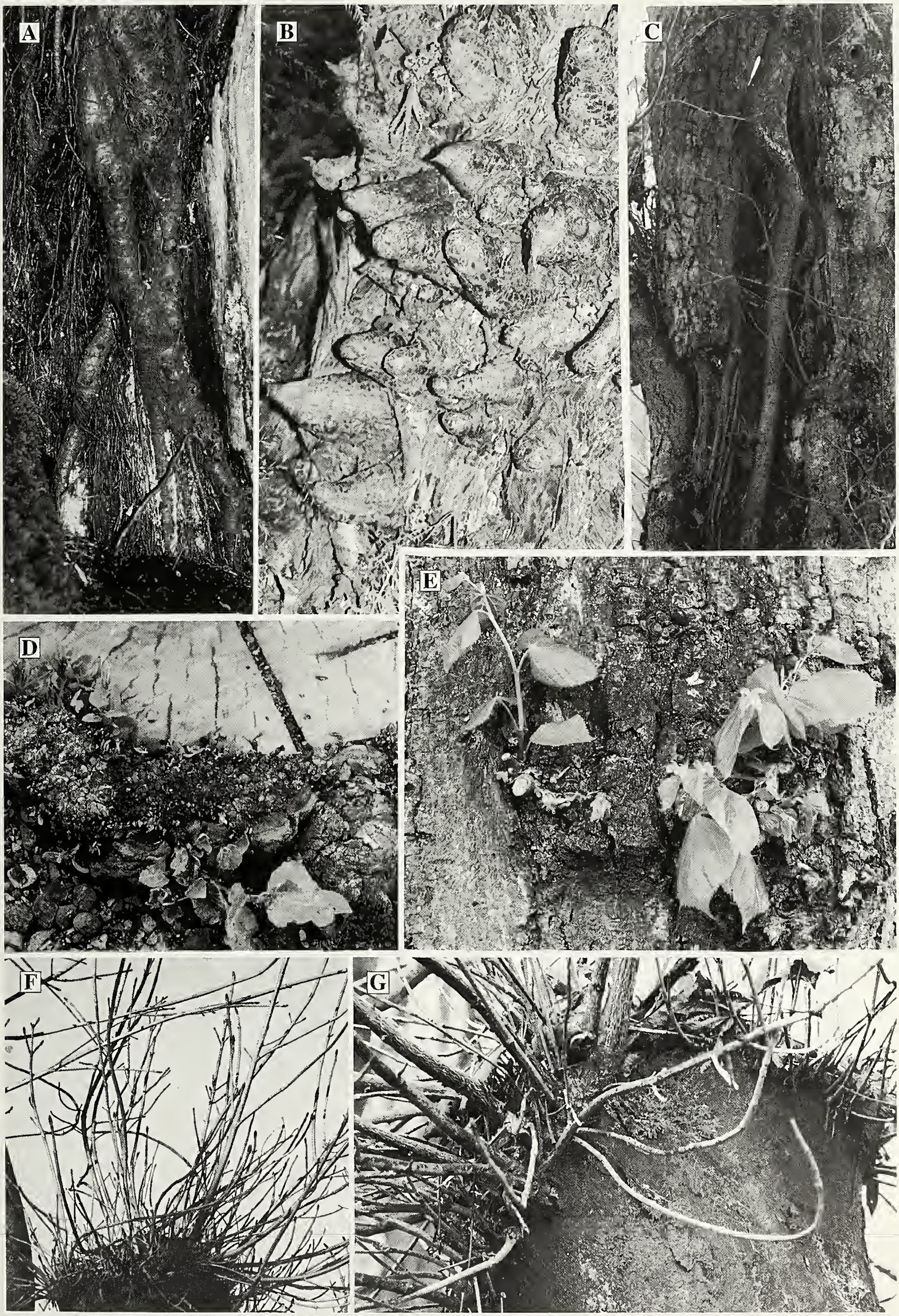
Fig. 3B. Very old yew tree *(Taxus baccata)* with 9-10 trunks all arising from a common coppice stool. Photographed 14/6/96 on Inchlonaig, Loch Lomond.

Fig. 3C. Old sessile oak tree *(Quercus petraea)* with 5-6 thick trunks arising from a high coppice (coppard) stool. Photographed 3/5/96 at Retreat Wood, Galloway.

Fig. 3D. Large, old sycamore *(Acer pseudoplatanus)* pollard with several thick branches arising from the bole at approx. 2.3m above ground level. Note the luxuriant growth of epiphytic fern in the crooks of the branches. Photographed 27/11/94 by track just south of Mugdock Castle.

Fig. 3E. Portion of a superficial root connected to the stump of a poplar tree *(Populus)*. Note the leafy adventitious bud which has arisen from this segment of root, whilst elsewhere on this root further buds are present. Photographed 5/10/95 by Kelvin Walkway at Kelvin Bridge, Glasgow.

Fig. 3F. Grove of coastal redwood trees *(Sequoia sempervirens)* which have developed from buds arising on the roots of the mother tree on the right. Photographed 10/6/96 at Younger Botanic Gardens near Dunoon.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NATURAL REGENERATION OF LIMES (*Tilia spp.*) IN SCOTLAND. WARM SUMMERS PRODUCE AN ABUNDANCE OF RIPE SEED.

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ABSTRACT

The appearance of large numbers of seedlings of Lime (*Tilia* spp), particularly in the north and west of the Glasgow area, in 1997 and less so in 1998, was apparently unprecedented and certainly not previously recorded in Scotland. A general survey of the north and west of Glasgow was reinforced by more detailed surveys of specific localities. Evidence of successful natural regeneration by seed in recent earlier years was also found and recent seedling evidence from other parts of Scotland is also given. The summer of 1995 was the warmest since at least 1959 and analysis of summer temperature data supports claims that temperature is the main environmental factor controlling successful production of ripe seed. The threshold temperature sensitivity of Small-leaved Lime (*T. cordata*) is higher than that of Large-leaved Lime (*T. platyphyllos*) and Common (hybrid) Lime (*T. x europaea*). Other factors, moisture, topography and genetics and their possible effects on germination are also discussed.

INTRODUCTION

In Scotland may be found, commonly planted, three species of Lime, of which none at present is considered to be native. The following descriptions are based on Pigott (1998a) and Stace (1997). In order of flowering they are:
a) Large-leaved Lime (*T. platyphyllos Scopoli*). Its leaves are 40 - 130 mm. in diameter with oblique leaf bases. The lamina has hairs on both surfaces, at least along the main veins. The side veins are prominent below. The stout petiole is usually less that 1/3 length of the lamina. The young shoots are hairy. The inflorescences are drooping with 1 - 5 flowers. The fruits are strongly ribbed, pubescent, largest of the three species and hard walled. It flowers from mid to late June.
b) Common (hybrid) Lime (*T. x europaea* Linnaeus, *T. x vulgaris* Hayne). Its leaves are hairless, except for white tufts in the vein axils below. The side veins are not prominent. The young twigs are soon glabrous. The inflorescences are drooping with 4 - 10 flowers. The fruits are oval, slightly ribbed, pubescent and intermediate between the two species. It flowers from late June to early July. Clones of hybrid Limes are widely planted.
c) Small-leaved Lime (*T. cordata* Miller). Its leaves are 30 - 70 mm. in diameter, cordate at the base, dull green and glabrous above and with tufts of rust coloured hairs in the vein axils below. The side veins are not prominent. The slender petiole is often 2/3 length of the lamina. The young twigs in the first year are glabrous. The inflorescences are erect, with 5 - 20 flowers. The fruits are unribbed, glabrous, small and fragile. It normally flowers from early to mid July in southern England, mid to end of July in northern England. In Scotland, where the latitudes are more northerly, Limes flower later (Lee, 1933).

T. cordata occurs typically where soils are deep, heavy and infertile, often but not always over limestone (Pigott & Huntley, 1978). *T. platyphyllos* is found on shallow, well drained soils on steep slopes of limestone. The distribution of *T. platyphyllos* correlates with this sort of topography throughout Europe including a few localities in England and Wales but this Lime is not found where these topographic features are lacking. The natural range of *T. cordata* includes areas of England and Wales but not Scotland; that of T. platyphyllos is more southerly but with a more montane distribution than *T. cordata* (Pigott, 1981a). *T. x europaea* is a natural hybrid in continental Europe and England where the parents grow in close proximity to each other and when their flowering time overlaps.

Lime trees are commonly found along streets and in established parks and gardens in Glasgow, as in other urban areas. They have been planted, probably as saplings derived vegetatively, as this would have been easier than regeneration from seed. This is particularly true of the hybrid which typically produces epicormic growths and occasionally suckers. Thus *T. x europaea* saplings were cultivated and planted extensively in many cities of Europe where they were relatively undemanding of soil type and tolerated city pollution well.

On account of generally lower summer temperatures in Scotland it has sometimes been considered that Limes were not capable of producing viable seed here at present. In 1985 Professor C.D. Pigott saw T. cordata seedlings in a flower bed under a large tree in the sheltered yard of a farm near Stirling Castle (Pigott, personal communication). In early spring of 1993 two saplings were found by MHH on an alkaline industrial spoil heap in Milngavie (NS 551746), c.21m from a Large-leaved Lime in a nearby garden (since then another sapling was found growing in the garden itself). Seeds of this tree were collected in October 1995, mixed with moist sand, kept in a refrigerator and sown in pots in February 1996. The pots were left outside until, on 13/4/97, seven seeds were seen to have germinated.

THE PHENOMENON OF 1997

Other seedlings were appearing in the Milngavie area at this time. This was reported in April by Prof. J.H. Dickson and MHH to Glasgow Natural History Society members, when RG and NRG realised that these explained the unfamiliar cotyledons of seedlings emerging in their gardens. Examination revealed that many were also appearing in other areas of nearby Hyndland and Dowanhill, Glasgow, beneath or close to established trees (*T. x europaea*). In natural sowings about 10% of fruits germinate after the first winter. Up to 20 seedlings per m^2 were seen in a few favourable areas protected by the shade of Limes from desiccation and full exposure to the prolonged sunshine of that summer. They did not appear in well-tended, heavily mulched areas and where they would have been disturbed during their expected 18 months below ground. They appeared in some open areas as well as under shade (e.g. hedge bottoms) or in grass lawns, but survival was poor if exposed to full sunshine or drying. Inspection of the surrounding area revealed other Lime seedlings, with a patchy distribution suggesting that only a few Limes had produced seeds that were both fertile and successful in germination (Map 1). The highly distinctive cotyledons (Figs. 1 and 2 - see Plate 2) of new seedlings were also recognised in some other locations in the north and west of Glasgow (Map 2). All three Limes have similar seedlings with palmate cotyledons.

Our survey of much of the area shown in the accompanying tables and maps revealed more than 40 seedlings of *T. platyphyllos* in 1997. Germination of *T. x europaea* in 1997 was locally prolific and could probably be measured in 100's if not more. No putative seedlings of *T. cordata* were observed in 1997 but a survivor from 1997 was observed at site 2b in 1998.

Perusal of more than twenty Scottish County Floras found no reference to Lime regeneration and outside the area of the maps of NW Glasgow the only reports of natural lime seed regeneration in 1997 include:
Perth, Tay Street - two seedlings of *T. x europaea* near 20 large hybrid trees; South Inch - seedlings beneath 8 out of 11 young (c.30 year old) Large-leaved Lime trees (probably *T. platyphyllos*). J. H. Dickson.
Baron's Haugh, Motherwell - c.15 - 20 seedlings of *T. x europaea*. Dr. P. Macpherson.

Other than these, no observations of seedlings were reported to us despite publicity to the members of Glasgow Natural History Society, the Botanical Society of the British Isles, the Royal College of Physicians and Surgeons, Glasgow, and communication with the Royal Botanic Garden, Edinburgh, the Forestry Commission and on the Internet.

REGENERATION IN 1998

Spring of 1998 brought a further flush of seedlings in the West End of Glasgow though in much smaller numbers than in 1997. In the Milngavie area germination was observed at only one site, Kilmardinny House, and this consisted of *T. platyphyllos*. Survivors of the 1997 regeneration were observed. Despite extensive searches the amount of regeneration was seen to diminish dramatically outwith the locations shown on the accompanying maps (1 and 2). As in 1997 the regeneration consisted mainly of the hybrid followed by *T. platyphyllos* and finally *T. cordata*. Overall the numbers were substantially lower than in 1997 but included two putative seedlings of *T. cordata* at site 2a. The general absence of seedlings under most Limes in and around the Glasgow area was striking, contrasting with higher numbers in a few specific places. In Tables 3, 4 & 5 and the Maps each number refers to the location of seedlings or saplings (all three Limes) or trees (*T. platyphyllos* or *T. cordata* only). The presumption has been made that the parent of a seedling is the nearest Lime. Details of the number of seedlings and saplings found are shown in Tables 2 and 3 and summarised in Table 1.

Table 1. Summary of 1997 and 1998 Lime regeneration

Species	**Survivors ('98)**	**New in 1998**	**New in 1997**
T. x europaea	24 (0 saplings)	>50<100	100's
T. platyphyllos	36 (inc. 10 saplings)	13	>40
T. cordata	3 (inc. 2 saplings)	2	0

SURVIVORS

Despite the prolific nature of *T. x europaea* regeneration in 1997, few survived into 1998, largely because the seedlings arose in garden areas susceptible to strimming, digging, weeding and being trodden upon. No saplings from the last decade were recorded.

In the few areas where *T. platyphyllos* regeneration was observed fewer losses occurred as the seedlings tended to be reasonably protected from accidental damage, e.g. in an untended area of the car park at Kilmardinny. More saplings of *T. platyphyllos* were recorded than of the other two species. A few are surviving regular hedge trimming in Kingsborough Gardens and two survive from last decade on the lime dumps in Milngavie.

T. cordata survivors are few, but the two saplings in Craigton Wood are significant and their age and origin are likely to be the subject of a separate paper. However it seems most likely they are survivors from last decade. The single surviving seedling in Kingsborough Gardens is protected by a metal fence and its continued survival should enable more positive identification to be made in the future.

During 1998 regeneration was closely observed and recorded in the garden at Hyndland Court. Of 53 seedlings of 1997, 11 grew leaves in April - May 1998 (survival rate 21%). The cotyledons of 16 new seedlings appeared during May (15) and July (one). None survived *in situ*, but one first year and five second year seedlings survived when protected in pots (Table 2). The cause of death was obscure in five, due to physical damage in six (by man, sunshine or 'drowning'), but was attributed to invertebrate predation in ten. Damage to cotyledons and leaves (partly or completely eaten) appeared to be due to slugs, beetles or earwigs, all of which are present in the garden, as also did damage to hypocotyls (partly nibbled) and roots (partly or completely disappeared). No evidence of voles or mice has been observed in this urban garden over more than 20 years; it is also patrolled by several cats and foxes. This contrasts with predation mainly by bank voles (*Clethrionomys glareolus*) in woodlands studied by Pigott (1985).

Table 2. Survival and deaths of Hyndland Court seedlings in 1998

Outcome	16 x 1st year seedlings	11 x 2nd year seedlings
Died (predation)	6	1
" (probable predation)	3	0
" (sun scorch)	1	0
" (drowned in pot)	1	0
" (strimmed in grass)	4	0
" (withered in pot)	0	5
Survived in pot	1	5
Survival rate:	1/16 = 6.3%	5/11 = 45%

FACTORS AFFECTING REGENERATION

Temperature

The conditions for fertilisation and seed development have been extensively studied by Pigott (1981a & b, 1991). The principal environmental factor that controls the production of viable seed is that of temperature at the time of pollination. In the case of *T. cordata*, at temperatures of less than 20°C. the growth of the pollen tube is slowed down so that it fails to reach the ovule before the tissue degenerates. Temperatures at or above 20°C. allow the pollen tube to reach the ovule and achieve fertilisation. Pollen tube germination occurs at temperatures above 15°C. but 20°C. is needed for fertilisation to occur during the day that a pollen grain is viable (Pigott & Huntly, 1981).

In the case of *T. platyphyllos* the corresponding suitable temperatures for fertilisation and seed development are some 3 - 4°C. lower than those for *T. cordata*. (Pigott, unpublished data). The first Lime to flower is *T. platyphyllos* in late June followed by the hybrid, *T. x europaea*, and *T. cordata* in early July. Hence pollination, mainly by flying insects, followed by fertilisation can occur in all three Limes in July and early August. *T. platyphyllos* has the advantage of flowering about a fortnight before *T. cordata*, which allows a longer period for growth, development and ripening of the fruits. Hybrids have similar requirements to *T. platyphyllos* for ripening and germination (Pigott, 1998). The apparent importance of the 20 degree threshold is substantiated by local data. Glasgow airport monthly mean maximum temperatures for June, July, August and September as far as possible back to 1959 are shown in Table 5. We are, of course, aware that the available temperature data from the Meteorological station at Glasgow Airport, a few miles away on a low, exposed site, will not exactly correspond to temperatures at the higher, sheltered urban environment of Glasgow city nor the higher ground at Milngavie/Bearsden, but should reflect these and significant trends. Records for these sites are not known to us. Table 5 shows that the 20°C. threshold was exceeded in July and August in 1997 and 1995. July and August of 1995 had the highest average mean monthly temperature maxima going back to 1959. Lime seed germination behaves like most other trees with medium sized fruits. Fertile Lime fruits which have dried naturally on the tree require two cold periods (i.e. winters) before germinating, although those sown immediately they are mature usually germinate after one winter (Pigott, 1991, Raekham, 1980). Therefore, the 1997 germination is likely to be related to the hot summer of 1995. One feature that distinguished 1995 from 1983 and 1984 was the high June temperature which was above 20°C. for the last 8 days of the month. The germination of 1998 was somewhat unexpected as the July mean of 1996 failed to meet the 20°C. threshold. If one year's dormancy before germination of viable lime seeds is usual then much germination can be anticipated in 1999 on the basis of the 1997 temperatures. Since 20°C. was not attained in July or August of 1998, germination in 1999 would derive from fertilisation in 1997.

The local long term averages of monthly maximum mean temperatures for July and August are 18.5 and 18.8°C. respectively, about 1.5°C. less than required for fertilisation and this would explain the widespread and usual lack of germination of lime seed in the Glasgow area.

Analysis of data back to 1959 shows that the 20 degree threshold was exceeded in both July (21.5°C.) and August (21.5°C.) of 1984, July (21.8°C.) and August (21.6°C.) of 1983 and July (21.6°C.) and August (21.9°C.) of 1976. The evidence in 1997 and 1998 in Kingsborough Gardens (*T. platyphyllos*), Clober Road (*T. platyphyllos*) and Craigton Wood (*T. cordata?*) of previous regeneration probably dating from the 1980's, may relate to the high summer temperatures of 1983, 1984 and 1989.

Temperature statistics for Turnhouse (near Edinburgh) show that over the period studied maximum mean temperatures for July and August varied similarly to that in the west. However, the Turnhouse maximum mean temperature for June 1995, the year of most interest was more than 1°C. lower than Abbotsinch. If temperature is the main factor controlling successful fertilisation, development and germination, then more reports of successful germination might have been expected from the east of the country. Lack of these reports suggest either lack of observation or the operation of other factors, such as moisture, referred to elsewhere in this paper.

Most of the literature on the relevance of temperature to fertilisation and subsequent germination refers to *T. cordata* only; but the local germination phenomena substantiate the experimental evidence (Pigott, 1998b) that *T. platyphyllos* and *T. x europaea* are less demanding than *T. cordata* in their temperature requirements for successful regeneration.

Moisture

Moisture is a significant factor in allowing germination to occur. For example, in the garden at 6 Prince Albert Road regeneration through the moss-filled lawns within a metre or two of the overhanging *T. x europaea* trees was prolific in 1997. Although germination did occur in the nearby borders directly beneath the trees it was not nearly so great in its extent as in the lawn. Also, in 1998, a germinating hybrid seedling was observed in the unused pebble covered carport, beneath a crack in the roof that allowed water penetration. The rest of the carport, quite dry, exhibited no signs of germination of any type of seedling. At Hyndland Court likewise in 1998 those seedlings that appeared in grass adjacent to *T. x europaea* did so in the lowest, most mossy and damp area thereof.

It has been shown (Pigott, 1991) that a high proportion of fertile seed collected in September and placed in **moist** soil in the open germinates the following April. However if the seed is air dried to a moisture content of 9.5% and then sown in the open, 10 - 15% germinate the following April and most of the remainder 18 months later. If the 1998 regeneration developed from the fertilisation of the 1997 hot summer then, on a moisture basis, the anticipated percentage germination in 1999 in this area might be considerably more than 1998.

In 1995, the September rainfall was 114.1 mm., considerably higher than normal, and would have helped to prevent desiccation of the already viable seed of that year. However the reason for the apparent lack of germination in 1996 is not clear.

Table 3 Sites of Natural Regeneration *Tilia x europaea*
(all sites on Map 1)

1 Crown Road North. a) N side. On 20/7/98 - 1 x '97 seedling; 1 x '98 seedling.
On 13/5/98 - 1 x '97 seedling. b) S side. On 20/7/98 - 3 x '97; 1 x '98 seedling. On 13/5/98 - 2 x '97; 4 x '98 seedlings.
2 Kingsborough Gardens. On 16/7/98 - 1 x '98.
3 Kingsborough Lane East. On 19/5/98 - 2 x '98.
4 Princes Lane. On 13/5/98 - 2 x '97; 1 x '98.
5 Sydenham Road. a) E side. 2 x '98. b) W side. In 1997 - c.53 seedlings. In 1998 - 11 x '97 seedlings; 16 x '98 seedlings.
6 Linfern Road. N side. Seedlings at BT entrance. 11 in '97; fewer (4) in '98.
None surviving.
7 Horselethill Road. On 22/4/98 - 1 x '98.
8 Kensington Gate Gardens. On 19/5/98 - 1 x '98.
9 Victoria Circus. a) E side. On 22/4/98 - 8 x '97; 10 x '98. On 16/7/98 - 2 x '97; 1 x '98.
b) W side. Seedlings in '97 gardens 6 & 10. On 12/5/98 - garden of No. 6 had 1 x '97; 4 x '98.
10 Prince Albert Road. a) N side. Up to 20 per sq.m. in '97 in gardens 2, 4 and 6.
About one third as many in 1998.
11 "Stazione". On 7/5/98 - 1 x '98 in grass verge between limes 5 & 6 from Great Western Road.
12 Devonshire Lane. On 21/5/98 - 1 x '98 under conifer near lime tree.
13 Balgray W gate. On 14/6/98 - 1 x '98.
14 Lilybank Gardens. At least 15 seedlings reported from 1997.

Table 4 Sites of Natural Regeneration
a) Tilia platyphyllos

2[1] (i) SE - 1 x '97 seedling observed in '98. (ii) SW - observed in '98: 2 x '98 seedlings; 4 x '97 seedlings; 6 older seedlings - ages to be determined.
15[1] On 12/5/98 - 5 x '97 seedlings; 1 x '98 seedling.
21[2] Several seedlings observed on 11/5/97.
22[2] 5 seedlings observed on 22/9/97.
23[2] 3 seedlings observed on 22/9/97. On lime dump across burn from presumed parent. Absent on 6/9/98. 2 saplings, 2.5 and 0.7 m. high, c. 21 m. from presumed parent. 2.5 m. sapling present in private garden of presumed parent.
24[2] Several seedlings observed in '97. None in '98.
25[2] 2 seedlings observed on 18/5/97.
26[2] 3 seedlings observed on 24.9.98. 2 x '97; 1 x '98.
27[2] On 7/6/98 - 12 x '97 seedlings in litter on tarmac; 7 x '98 seedlings on tarmac; 2 x '98 seedlings in moss/rhododendron undergrowth; 2 x 3+ year old seedlings on tarmac; also 1 x c. 5 year old.

b) ***Tilia cordata regeneration?***

2[1] a). On 6/5/98 - 2 x '98 seedlings. b). On 16/7/98 - 1 x '97 seedling.
28[2] 2 x saplings. Species not certain. Ages to be determined.

[1] = Map 1; [2] = Map 2

Table 5 Locations of observed trees
a) ***Tilia platyphyllos sites***

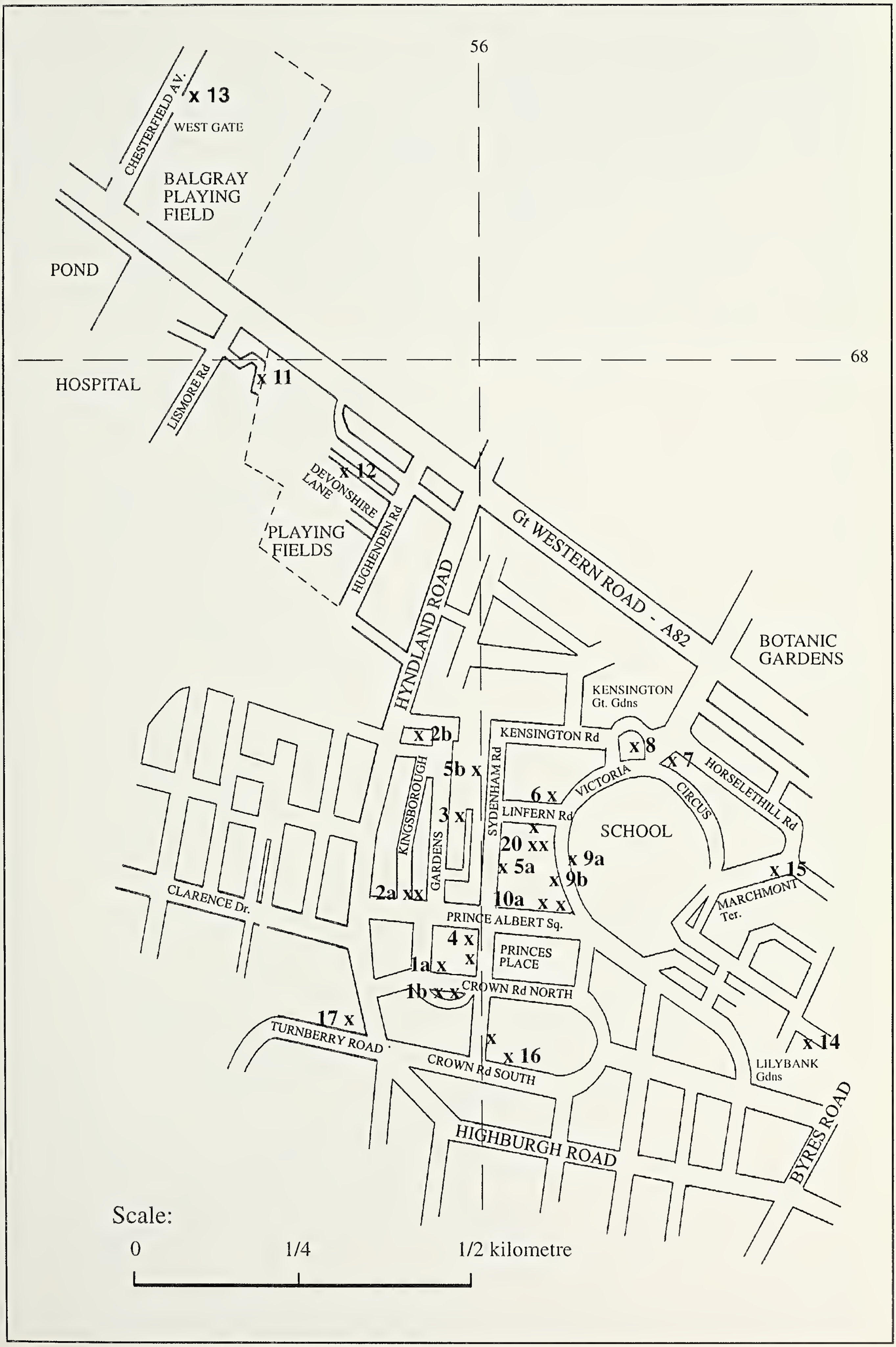
2[1] NS559674/6. Kingsborough Gardens. (i) SE. 1 tree. (ii) SW. 3. (iii) Rectangle. 1.
15[1] NS565674. Marchmont Terrace. 5 trees.
21[2] NS641753. Craigton Wood - W end, near Douglas Academy.
22[2] NS552748. Milngavie C.E. Centre. 25" circumference.
23[2] NS551746. Clober Road private garden. 100/200 years. 24 metres high.
24[2] NS552746. Allander walkway.
25[2] NS554749. Drumclog Moor. c. 6 trees 30-40 years old.
26[2] NS525695. Clarion Crescent quadrilateral. c. 20 trees.
27[2] NS550727. Kilmardinny. 14 feet circumference. 150/200 years old.
29[2] NS528765. High Craigton. 150" circumference. 13 metres high. Stunted.
30[2] NS559749. Old driveway at Dougalston Estate.

b) Tilia cordata sites

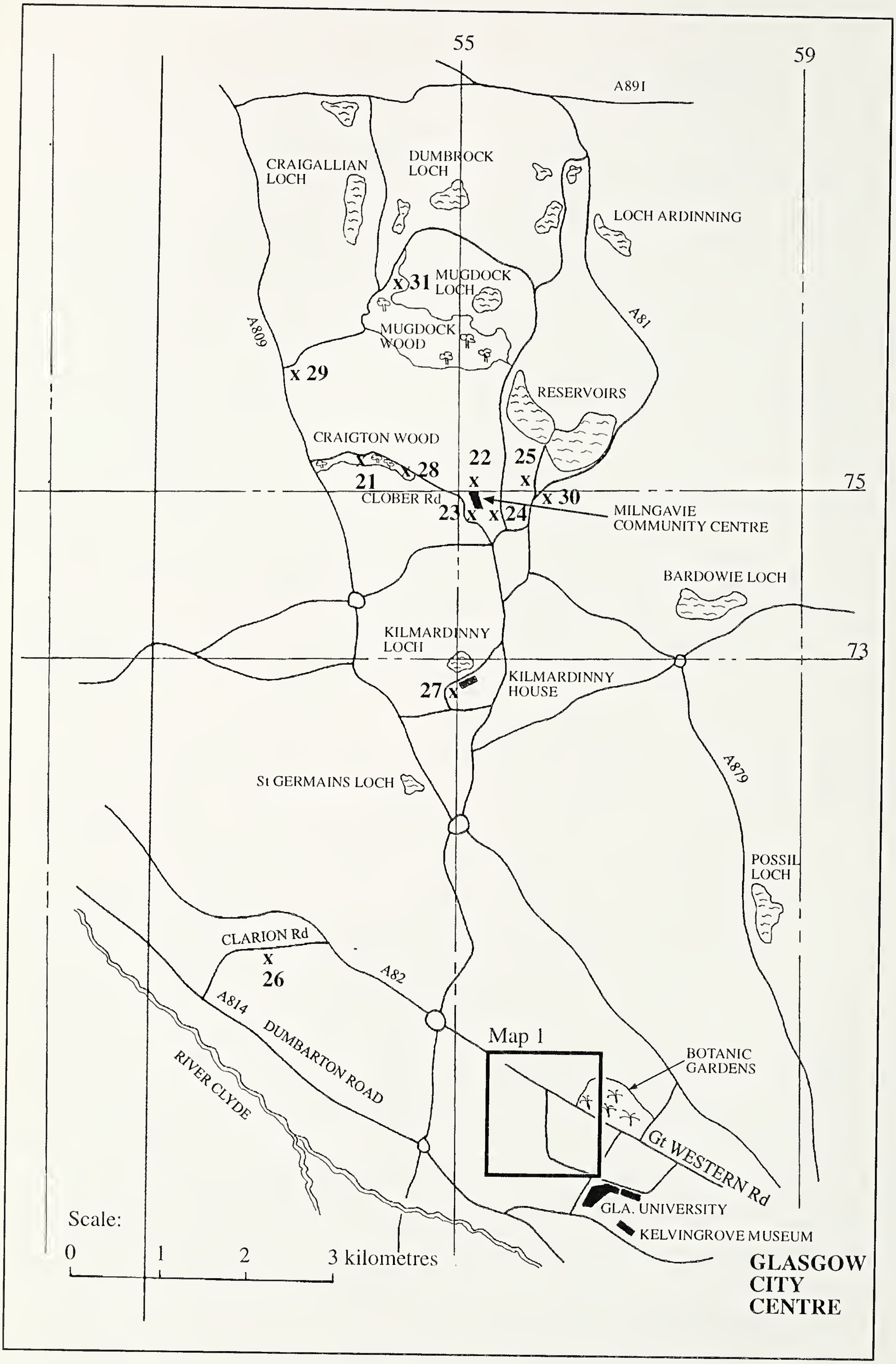
2[1] NS559674(6). Kingsborough Gardens. a) Main garden. 6 trees.
b) Rectangle. 5 trees.
16[1] NS560671. Crown Road South. 2 trees. Opposite entrance to "Rock" car park.
17[1] NS558672. Turnberry Road. 1 tree. At junction with Hyndland Road.
18[1] NS562(3)676. Kensington Road. 3 trees.
19[1] NS562675. No.2 Victoria Circus. 2 trees.
20[1] NS561675. No.10 Victoria Circus. Ramoyle garden. 3 trees.
28[2] NS542753. Craigton Wood. (i) Parent? c. 108" circumference. (ii) Coppice. (iii) Coppice.
31[2] NS543778. Craigend roadside. (I) 140" circumference. c. 18 metres high. Non-coppiced. 16 metres away from (ii) 98" circumference. 7 m. high.

[1] = Map 1; [2] = Map 2

Map 1: Sites 1-20



Map 2: Sites 21-31



Genetics

The localised nature of the regeneration phenomena observed and the fact that hardly any regeneration has been reported by competent observers outwith this area suggests that some Glasgow West End trees may belong to particularly fertile clones. Hybrid clones have been widely planted since the sixteenth century and virtually all the hybrids, which exhibit dense epicormic branching, appear to belong to clonal group 'Pallida', one of the two clonal groups recognised by Pigott (1992). The Large-leaved Limes, however, are more scattered in their distribution through NW Glasgow and appear to be more fertile than the Small-leaved Limes found in this area.

CONCLUSIONS

The main environmental factors controlling the northerly distribution of *T. cordata* and *T. platyphyllos* are temperature and topography respectively. The minimum temperature for the production of fertile fruits is about 20°C. in the case of *T. cordata* and somewhat less for *T. platyphyllos* and *T. x europaea*. The Lime regeneration observed in 1997 consisted of *T. platyphyllos* and *T. x europaea*. No *T. cordata* regeneration was observed that year. Apart from the lower temperature needed for successful fertilisation the earlier flowering of *T. platyphyllos* and the hybrid allows a longer time for the development of the embryo than is the case with *T. cordata*. The time of flowering for *T. cordata* is already later at these northerly latitudes and so the combined effects of a higher temperature requirement and later flowering provide a likely explanation for the rarity of *T. cordata* regeneration in Scotland.

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PLANT RECORDING IN UPLAND LANARKSHIRE (VC 77)

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Referring to that part of the Southern Uplands which lies within Lanarkshire, Mackechnie (1958) wrote that it was unlikely that this part of the County had been thoroughly explored by field botanists, but that it was also improbable that spectacular botanical discoveries would be forthcoming from it in the future. The area in question is vast in terms of southern Scotland and because it is still considered to be relatively uninteresting botanically, is very seldom surveyed by visiting botanists.

The Botanical Society of the British Isles is currently engaged in a project to update botanical records throughout the British Isles with a view to producing an Atlas 2000 of the British Flora. The plant recorder for Lanarkshire (PM) realised that if the upland parts of VC 77 were to be surveyed adequately, then help would be required. Accordingly, it was arranged that during 1997 and 1998 recording would be carried out in the more remote areas and on the higher ground. This work was carried out by the other author (KW).

RECORDING

Atlas 2000 mapping will be on a 10km square basis but as the basic recording in Lanarkshire is being done in quadrants (5x5km), the Field Cards were completed in the latter format. Recording took place in 25 quadrants (Fig. 1). Where only part of a quadrant is within Lanarkshire, only the plants in that section were recorded.

Area surveyed

Most of the recording was undertaken in the area bordering Dumfriesshire (VC 72). The high ground here comprises the arc of the Lowther Hills which stretch from near Leadhills to the south round the Daer Reservoir and up on the east side as far as the Peeblesshire (VC 78) border. Recording on the west was, however, carried out as far north as Cairn Table (593 metres above sea level; NS 7.2 SW) which is on the boundary with Ayrshire (VC 75). Individual components on the south included Well Hill (606m; 9.0 NW), Ballencleuch Law (691m; 9.0 SW&NW), Shiel Dod (668m; 9.0 SW) and Gana Hill (668m; 9.0 SE). Adjacent to Peeblesshire are the hills to the west of Camps Reservoir and those of the Culter Valley, including Culter Fell (748m; NT 0.2 NE) and to the north the Black Mount hill complex (516m; 0.4 NE) which descends to a plain one mile from the Peeblesshire border. Further to the north there is Dunsyre Hill (400m; 0.4NE) and towards the north-east corner of VC 77 there is Bleak Law (445m; 0.5SE), just to the south west of the junction of Lanarkshire, Peeblesshire and Midlothian (VC 83). Additional high ground surveyed included Tinto (707mm; 9.3 SE & NE). The small part of 8.1 NW which lies within VC 77 had already been recorded. Similarly, 0.1 SW was not included in the survey because practically all the high ground is afforestated and therefore unlikely to be productive botanically. Further, the A 74 runs through this area and the road sides and lower slopes on both sides had been recorded previously. The locations of some of the hills surveyed, with heights in metres, are shown in Fig. 2.

Habitat descriptions

The habitats of the survey area typically comprise grazed, acidic grassland or heather dominated moorlands, sometimes in complex mosaics but frequently they are represented as discrete units, reflecting the local management regimes. The acidic grasslands are characterised by fine-leaved fescue, mat and wavy-hair grasses and broader-leaved bent grasses, usually with a limited range of associated herbs and mosses. The moorlands, often maintained by muirburn, range from dry heaths on freer draining slopes and ridges to wet heaths or blanket bogs of shallow slopes, depressions or plateaux.

The higher moorland ground is of interest for supporting Crowberry (*Empetrum nigrum*), Cowberry (*Vaccinium vitis-idaea*) and Common Cow-wheat (*Melampyrum pratense*), with the locally abundant Cloudberry (*Rubus chamaemorus*) and occasional Lesser Twayblade orchid (*Listera cordata*) being features of high altitude blanket mires. The short turf of exposed, higher summit plateaux can support populations of Stiff Sedge (*Carex bigelowii*) and occasionally stands of Great Wood-rush (*Luzula sylvatica*).

Local areas of calcareous grassland, flushes and rock outcrops or screes, often associated with burnside locations, which additionally support relic areas of scrub woodland, add to the overall habitat diversity and make significant contributions to the local flora.

The locally frequent, but small calcareous flushes are notably species rich and typically support various short sedges (eg *Carex pulicaris, C. dioica, C. flacca, C. hostiana, C. viridula* ssp. *brachyrrhynca* and ssp. *oedocarpa*), Quaking-grass (*Briza media*), Few-flowered Spike-rush (*Eleocharis quinqueflora*), Grass-of-Parnassus (*Parnassia palustris*), the eyebright (*Euphrasia scottica*) and Lesser Clubmoss (*Selaginella selaginoides*). In addition, other acidic flush or burnside habitats may have Hairy Stonecrop (*Sedum villosum*), Mossy Saxifrage (*Saxifraga hypnoides*) and Starry Saxifrage (*S. stellaris*).

The freer draining calcareous grasslands can support additional species diversity with records including the oat-grasses (*Helictotrichon pubescens* and *H. pratense*), Bulbous Buttercup (*Ranunculus bulbosus*), Wild Thyme (*Thymus polytrichus*), Fairy Flax (*Linum catharticum*), Common Milkwort (*Polygala vulgaris*), Common Rock-rose (*Helianthemum nummularium*) and Mountain Pansy (*Viola lutea*).

Rock outcrops or scree provide refuges from heavy grazing or heather domination and can support various ferns,

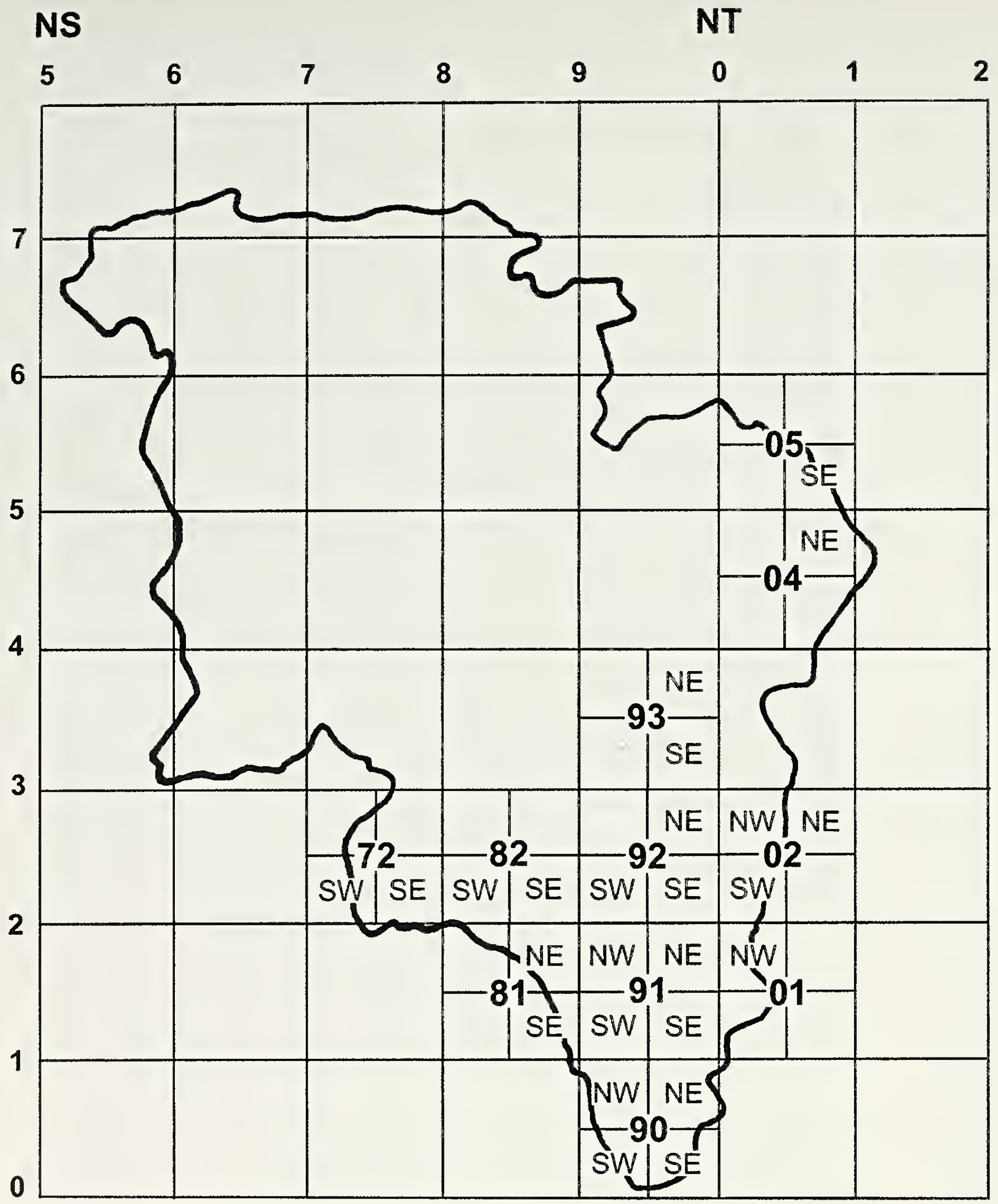

Fig 1 Lanarkshire (VC 77) Boundary showing 10km and quadrant squares in which recording took place during the survey.

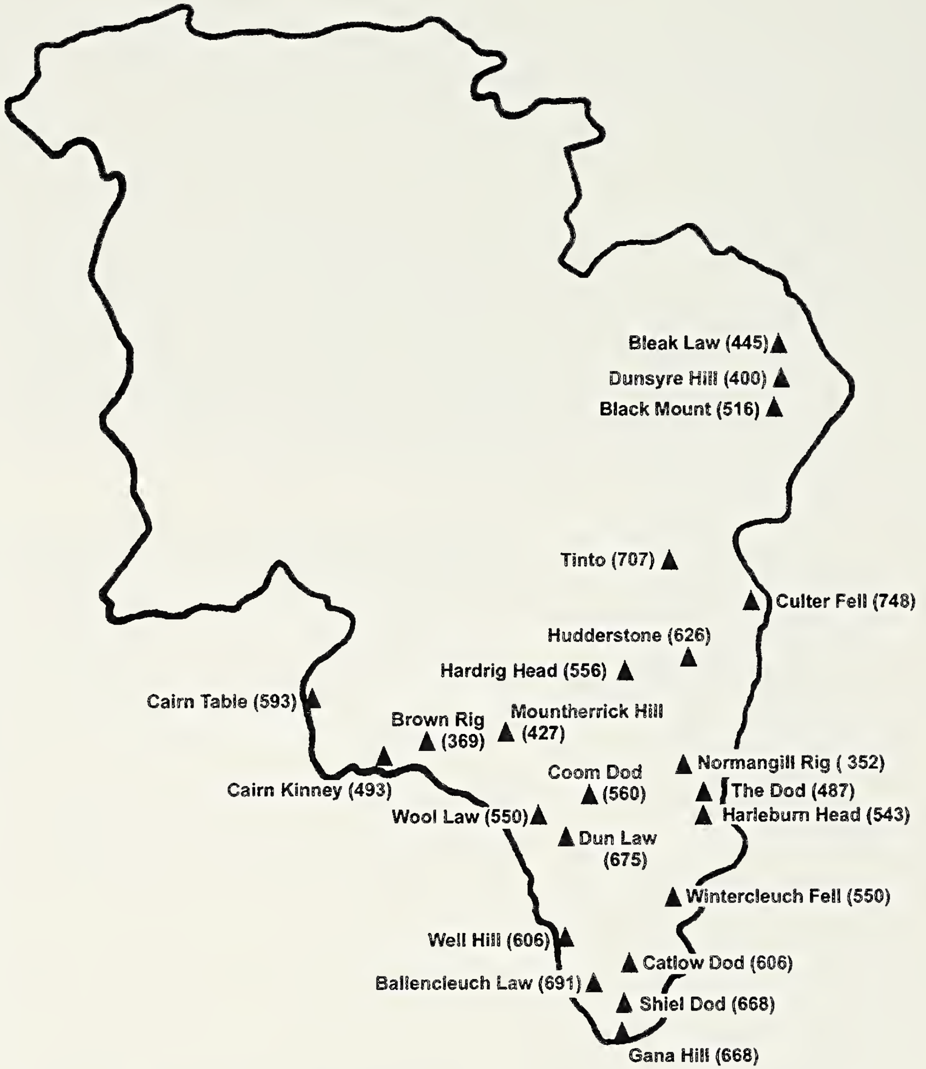

Fig 2 Some of the hills surveyed with heights in metres. The ▲'s indicate the position of the hill tops.

clubmosses (including *Lycopodium clavatum, Diphasiastrum alpinum* and *Huperzia selago*), hawkweeds (*Hieracium spp.*), Goldenrod (*Solidago virgaurea*) and Viviparous Sheep's-fescue (*Festuca vivipara*). The rock outcrops along sheltered water courses can support relics of scrubby woodland typically with Rowan (*Sorbus aucuparia*) plus willows, occasional Hazel (*Corylus avellana*) and rarely Aspen (*Populus tremula*); the varied herbaceous flora can include Wood Crane's-bill (*Geranium sylvaticum*), Slender St John's-wort (*Hypericum pulchrum*), Bitter Vetch (*Lathyrus linifolius*) and Stone Bramble (*Rubus saxatilis*).

RESULTS

The survey resulted in the accumulation of almost 2000 records that otherwise would not have been made, but was particularly rewarding on account of the considerable number of local and national rarities which were recorded (Table 1). Of very special interest was the recording of four new VC records. Alpine Meadow-rue (*Thalictrum alpinum*) was seen at one site. In the *Atlas of the British Flora*, Perring and Walters (1962) give four records for the south of Scotland, two in Kirkcudbrightshire, one at the the Dumfriesshire-Peeblesshire border and one in Peeblesshire. Alpine Saw-wort (*Saussurea alpina*) was recorded also from one site. Perring and Walters give three south of Scotland sites, two in Kirkcudbrightshire and one at the junction of Dumfriesshire, Peeblesshire and Selkirkshire. Pale Forget-me-not (*Myosotis stolonifera*) was seen at three sites, whereas it was previously known from two in southern Scotland, one at the boundary between Peeblesshire and Selkirkshire, the other at the junction between these vice-counties and Dumfriesshire. The hybrid eyebright, *Euphrasia nemorosa x E. scottica* was confirmed (A.J. Silverside) from one site.

Table 1. Examples of new records, made during the survey, of relatively rare Lanarkshire plants.

Species	Previous 1987+ quadrant records	Quadrant records added by survey	First ever 10km square records
Alpine Clubmoss	5	1	1
Fir Clubmoss	2	2	1
Lesser Clubmoss	3	10	1
Mountain Male-fern	2	2	1
Parsley Fern	4	5	2
Limestone Bedstraw	3	4	3
Stone Bramble	4	3	3
Cloudberry	3	13	6
Cowberry	6	17	6
Common Cow-wheat	6	10	4
Eyebright (*E. micrantha*)	2	3	2
Eyebright (*E. scottica*)	2	8	6
Grass-of-Parnassus	9	6	4
Mossy Saxifrage	2	5	1
Few-flowered Spike-rush	5	6	4
Hairy Stonecrop	6	13	2
Lesser Twayblade	3	3	1
Brown Sedge	13	8	5
Dioecious Sedge	6	8	2
Pale Sedge	5	9	1
Smooth-stalked Sedge	2	2	2
Stiff Sedge	4	2	1
Tawny Sedge	6	11	3
Tawny x Yellow-sedge	1	2	2
Long-stalked Yellow-sedge	6	2	2
Viviparous Fescue	5	7	1
Downy Oat-grass	5	5	3
Meadow Oat-grass	3	5	3

CONCLUSIONS

A summary of the recording results highlighting local areas of species richness or rarity is available from the authors and this data will hopefully be of wider use for the nature conservation of the area. In the sense that he considered Upland Lanarkshire to be under recorded, Mackechnie (1958) has been proved correct, but with regard to new vice-county records he would have been delighted to have been proved to be wrong.

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REFERENCE

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THE ANCIENT OAKS OF CADZOW

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ABSTRACT

The ancient oaks at Cadzow, near Hamilton, are decribed. They are notable in their size, their twisted growth forms ("stagheadedness") and their apparent age. There are now 328 trees in an area of wood pasture. They appear to be hybrids between *Q.robur* and *Q.petraea* although they show more *Q.robur* characteristics than *Q.petraea* characteristics. The past management of the oaks is investigated. Historical references to the oaks exist in both published literature and in surviving estate records. These show that the trees have been valued for centuries and that they were formerly an integral part of the Dukes of Hamilton's chase, wild white cattle and deer being the animals hunted. There is no documentary evidence for the belief, that is widely held today, that the trees were managed by pollarding and that this is what has resulted in their unusual habits. An analysis of annual rings, from samples dating back to 1444, confirms the absence of pollarding. Old maps show the presence of the oaks from the late 16th Century onwards and it is concluded that there is a high probability that the oaks originate from primeval woodland. Individual stumps can be dated back to the 15th Century and it is probable that some of the existing trees pre-date this, possibly by several centuries.

DESCRIPTION OF THE CADZOW OAKS

Even the most casual observer cannot fail to be struck by the appearance of the Cadzow oaks. They constitute a most noteworthy stand of trees, obviously ancient, striking in their appearance and intriguing in their history. Seeing these trees in winter one might assume them to be dead - bizarre shapes with hollow trunks and jagged crowns. Yet each spring new shoots appear from the gnarled stems, contrasting starkly with the wrinkled grey bark and the rust-coloured centres of the split open trunks. The trees are by no means moribund, flowering and fruiting occurring in no more haphazard a fashion than is the norm for oak trees in the British Isles (Dougall, 1994). For a general discussion of oak regeneration see Watt (1919), Jones (1959), Shaw (1974), Rackham (1980) and many others.

There are presently 328 trees, mostly scattered over farmland just south of Hamilton in an area known as Hamilton High Parks (NS 7353) (Fig. 1). This was formerly part of an estate belonging to the Dukes of Hamilton which included Hamilton Palace (now demolished) and also Chatelherault, a hunting lodge built in the 18th Century and still standing today. Indeed the lodge is the centrepiece of Chatelherault Country Park in which a few of the oaks stand. The majority are on farmland which is privately owned and currently used as pasture; cattle graze on improved grassland among the trees.

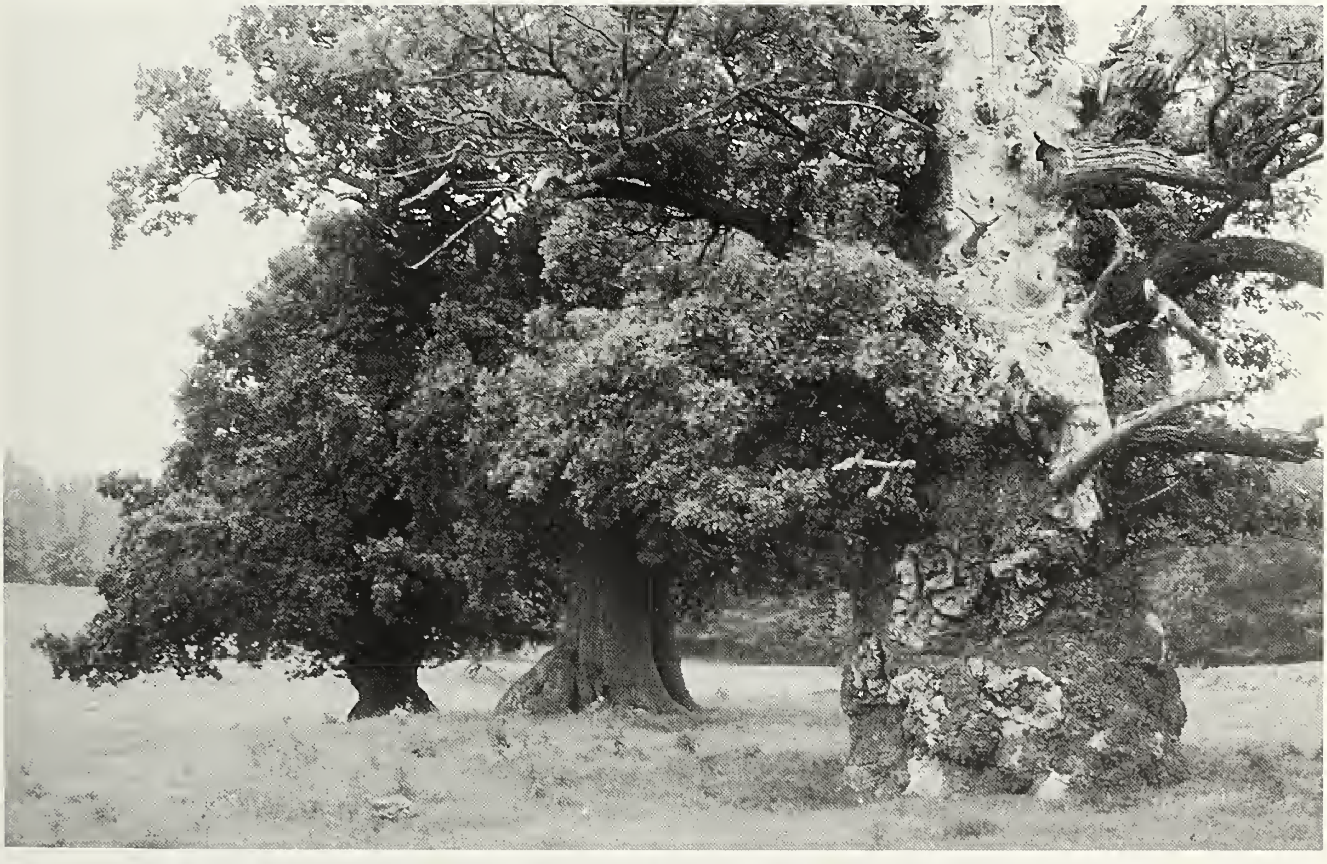

Fig. 1 A view of the Cadzow oaks in summer. The tree in the foreground has healthy boughs, despite the level of dieback. Notice the bulbous shape and epicormic growth. The trees in the background have more slender trunks.

Many of the Cadzow oaks are quite small and there are only a few with a full spreading crown. The majority suffer from a very severe "stagheadedness"; the uppermost boughs are long dead, only jagged crowns remaining, and in many cases whole portions of the crown are entirely absent. Indeed some of these trees measure no more than 3m in height and are no more than 3-4m in crown diameter. Although most are significantly bigger than this, Rackham (1980) describes this stagheadedness as a normal feature of tree development. The tree "reduces its commitments" and can thereafter grow a new crown should conditions improve.

Virtually all the trees share this stagheadedness and none are large typical "parkland" oaks. This may largely be attributable to their age although various other possibilities exist (see below). Closer inspection of the trees shows that there are essentially two main groups (Fig. 1):

A) "Bottle-shaped trees", somewhat swollen at the base with relatively short stumpy trunks. The boles of these trees are often densely covered in an epicormic growth, although there may be a pronounced browseline below which the growth consists only of bare twigs. Partly as a result of these massive outgrowths on the trunks many of the Cadzow oaks have attained an enormous girth. In his description of the British species of *Quercus* Jones (1950) states that both species of oak, *Q.robur* and *Q.petraea*, occasionally attain girths of 35-40 feet but that "girths greater than 20 feet seem to be exceedingly rare in Scotland". At Cadzow there are eleven trees with a diameter greater than 20 feet, the largest measuring 25 feet (7.62m) in girth. This tree is some 10m in height and its crown diameter is 12m x 11m. Two other trees measure approximately 25 feet in girth. The general proportions of these trees are typical of many of the Cadzow oaks: their enormously wide trunks are actually very short and are topped by small broken and open crowns.

B) More upright and slender trees, often slightly sinuous in shape, the crown sometimes more open with a lower twig density. First impressions might suggest that these trees are simply not of a great age and that this is what results in their narrower, less gnarled trunks. Analysis of cut stumps shows that this is not the case. A spectacular example of this is a cut stump, girth only c.12 feet (360cm), in which at least 440 annual rings can be counted. Allowing for the decay of the now absent sapwood it is clear that this tree began life before the year 1500.

These "type B" trees may in some cases appear outwardly more intact and healthy than the "type A" trees. However closer inspection almost always reveals that these trees are also hollow inside. The main difference between the two types is partly the presence of the burrs, ridges and dense epicormic outgrowths which are so characteristic of the "type A" trees.

Taxonomic analysis of both types of tree show that, as is so characteristic of oak trees growing in Scotland (Cousens 1962, 1963, 1965) there is a mixture of *Quercus robur L.* and *Quercus petraea (Matt. Liebl)* characteristics. In order to quantify the variation between the trees a hybird index was constructed (method based on Wigston 1975). It was found that the trees were taxonomically closer to *Q.robur* than to *Q.petraea*. A possible explanation of this is that at some stage hybridisation occurred between the two species and that this was then followed by introgression with *Q.robur*, resulting in the present population of trees with predominantly *Q.robur* characteristics. For full details of this taxonomic analysis and a more detailed account of the Cadzow oaks see Dougall (1994).

In 1997 young oak trees were planted amongst the ancient oaks by Scottish Natural Heritage, in agreement with the landowner, Mr Rober Wiseman. These are seedlings of the old oaks themselves which were raised from acorns collected in previous years. An attempt was made to plant the seedlings close to their mother plant.

HOW OLD ARE THE CADZOW OAKS?

Local folklore states that the Cadzow oaks date from the 12th Century. For example the author of the *New Statistical Account of Scotland* (1845) states that they were planted about 1140 by David I. This statement raises two intriguing and interconnected questions:

a) Is this an example of ancient woodland?

b) Were the trees indeed planted or are they growing there naturally?

Rackham (1980) defines an ancient wood as one which has been present since A.D. 1700 or earlier and Peterken (1981) considers pre-1600 woodland as ancient.

There is clear evidence that this area of wood pasture was in existence in 1600, thereby fulfilling even the more stringent criteria. The earliest map found which covers this area is in Blaeu's *Atlas Novus* of the 17th century (Blaeu 1654). The 47 maps covering Scotland are based on the manuscript field documents of Timothy Pont, his surveying of Scotland probably having occurred between 1583 and 1601 (Royal Scottish Geographical Society, 1973). The relevant map, *The Nether Warde of Clydsdail, and Baronie of Glasco* - is the only one based on a dated Pont manuscript (1596) and moreover this is one of the most comprehensively detailed maps in the atlas (Stone 1991).

What this map shows is of no small significance. In an otherwise largely treeless landscape there is an extensive area of woodland shown in what is clearly the present location of the Cadzow oaks. Despite the fact that there are some clear anomalies in the map, e.g. the orientation of the Rivers Clyde and Avon, there is little doubt that this is the correct area. Place names marked on the Blaeu map can clearly be matched up with those on modern maps and there is the clear landmark of Cadzow Castle, now a ruin close to the old oaks. This map proves that there was an extensive area of woodland here at the end of the 16th Century. The trees consistently appear on all subsequent maps e.g. General Roy's map of the mid 18th Century shows the trees in considerable detail (*The Military Survey of Scotland 1745 - 1755*). These maps show that Cadzow is undoubtedly an area of ancient "woodland" (or more correctly ancient wood-pasture), whether planted or not.

In most cases any wood of such an age will be of natural origin, rather than planted (Rackham 1980). Such a claim can be substantiated by considering the history of British woods; the destruction of woods has far outweighed their creation and

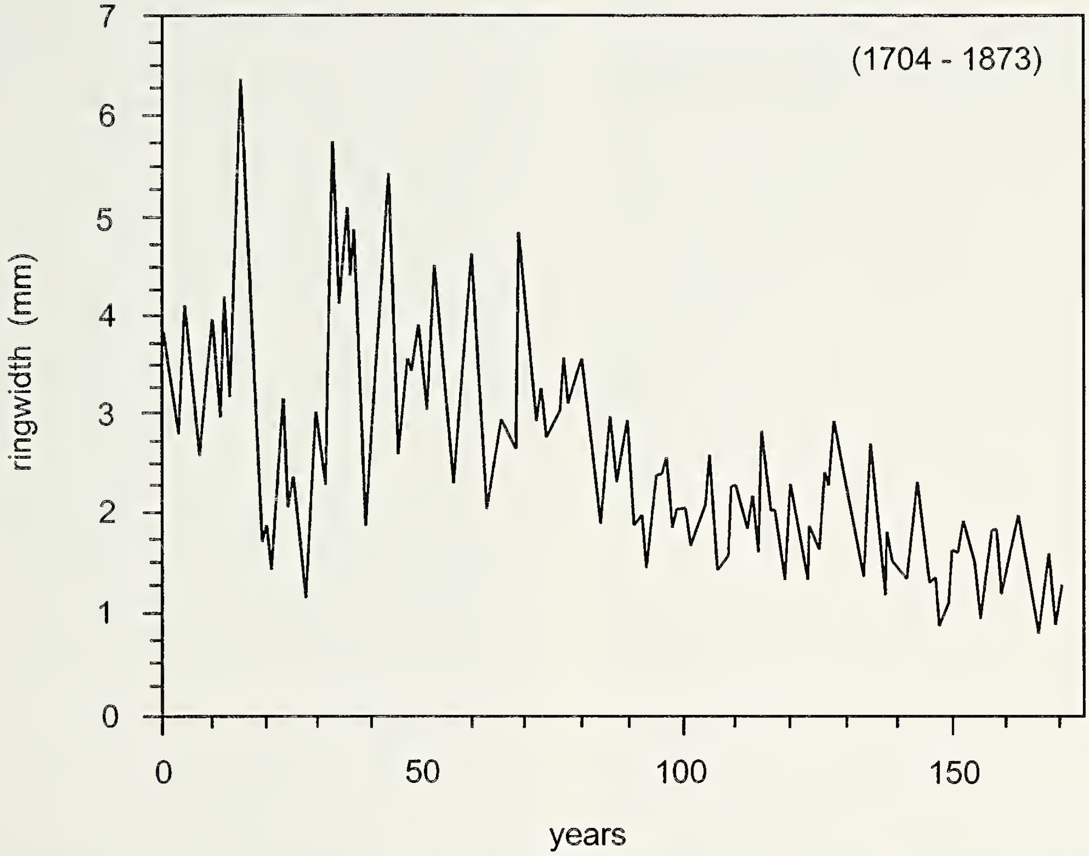

Fig. 2 Ringwidth measurements for one of the Cadzow oaks. Although ringwidth fluctuates considerably, there is no evidence of pollarding.

secondary woods of known age are very rarely older than 300 years old. Steven & Carlisle (1959) define ancient woodland (which is slightly different) as woodland which became established in Scotland during post-glacial times without human influence and which has since descended from one generation to the next by natural means.

There are three main possibilities for the origin of the wood:
a) The trees were planted (by David I or some other).
b) The trees are present as a result of natural regeneration but the wood is still secondary. This would mean that there has not been continuous woodland cover on the site. Instead some factor, anthropogenic or natural removed the trees and they naturally recolonised.
c) It is an area of primary woodland. There would thus have been uninterrupted cover of trees since the last Ice Age retreated and colonisation of the exposed land took place. Pollen analysis of sites throughout this area of Scotland has shown that 8000 years ago oak colonisation had occurred from the south, such that by then it was a major forest component (Birks, 1989).

Both Rackham (1980) and Peterken (1981) state that is almost impossible to assess whether or not an ancient woodland is primary. However in nearly every case it will be on a primary woodland site. This is surely the case for the Cadzow oaks. It is not conceivable that an area of gently sloping ground at an altitude of 100m in this part of Scotland would not originally have been wooded.

Is the wood then primary or secondary in nature? The interference by man over the centuries has been such that little information can be gained about the origin of the trees by looking at their present nature and composition. Although standard ecological observation can be made their interpretation is problematic. For example if the trees had the appearance of an even aged stand this would not necessarily imply that the area was secondary (planted or otherwise) as might have been the case with a young stand of trees. At Cadzow such a pattern, if present, might simply result from all the oldest trees having died, leaving only the youngest. And if it were found that the trees had a greater uniformity of growth habit, fruiting characteristics etc, than one might expect in a natural population this would not necessarily have resulted from the planting of a crop of acorns of related or similar parentage. It is equally possible that the management of wildly growing trees over the centuries selected those trees that exhibited desirable characteristics. A relatively homogeneous stand could thus have been nurtured from a disparate natually occurring mixture of individuals by selective culling of undersirables.

The most significant feature of these trees is their age; the greater their age the smaller the likelihood of them having been planted. The oldest dated stump on the site is from 1444 and has 440 visible annual rings, as already described. It is possible that some of the living trees may be even older. The remarkable feature of this stump is that despite at least 440 years of growth it is quite small. Its girth is only c.12 feet (360cm) and its radius is only 60cm. Many of the living trees are considerably larger, even twice the size and so one might deduce that they are even older.

"Coring" the trees would theoretically provide an accurate assessment of their age. The technique involves the use of a Swedish increment corer which is bored into the centre of the trunk. When unscrewed a thin core is removed from the tree and this will contain a record of the annual rings in the xylem. The amount of tissue removed is minimal and the hole in the bark is then plugged with a wooden dowel, thereby reducing the danger of infection. The age of a living tree can then be assessed. Permission was received from the landowner, Mr Robert Wiseman, and from the Nature Conservancy Council (now Scottish Natural Heritage) to core some of the trees in order to establish their age.

It was always realised that the hollow centre to the trunks would mean that the core was incomplete; however it was hoped to obtain some measure of the rate of growth. This could be achieved by measuring how many years were required to effect a given increase in girth and then extrapolating from this to provide an overall estimate of the age of the tree. Potential sources of inaccuracy, such as the normally faster growth in the early years of a tree's life would have to be accounted for, but it was still hoped to obtain some estimate of the rate of growth.

Attempts at coring had little success. The main problem was that the decay in these trunks was such that only very limited portions of the trunk were intact and usable. This meant that no useful cores were obtained.

Nonetheless it is still possible to estimate the age of the trees. As stated, the girths of some are considerably larger than the average for oak trees and this is one of the unique aspects of the Cadzow oaks. However this large girth is often allied to a small crown and this combination is highly significant. If a tree can only produce a small crown then its rate of growth will be limited and so more years will be required to achieve a given girth than one which can produce a large crown.

The peculiar combination of a large girth and a small crown is exemplified by the tree already described. Outwardly it appears to be the oldest of the oaks as it has the largest girth and yet also has a very small crown. From measurements of circumference this tree has a diameter more than double that of the cut stump described above with its 440 annual rings. If one allows for a similarly slow rate of growth then an age of 800-900 years is obtained and it would thus have begun life sometime around A.D. 1100.

Such extrapolation of data from one tree to another is obviously fraught with hazards and this estimate of the tree's age must be treated with caution. Nonetheless such trees are not unknown. Schadelin (1905) described a *Q.robur* "torso" 16m tall and of 759cm girth on St Peter's Island, on the Lake of Biene, Switzerland, which was at least 930 years old (on the basis of ring counts). Such a tree is not unique. Dickson (1993) discusses the age of yew trees in Scotland, the celebrated tree of Fortingall in Perthshire perhaps being well in excess of 1500 years old. Jones (1959, page 192) states "Undoubtedly declining oaks may remain alive for a very long time, so that it is not improbable that some of our bigger decrepit trees are of a comparable age to the above two trees." (He is referring to this oak from Switzerland and another slightly younger tree.)

Mitchell (1974) uses the growth rates of oaks of known age to calculate typical growth rates and these are generally more rapid than that measured at Cadzow. If this ancient individual at Cadzow had grown as indicated by him then its age would be considerably less than predicted above. Nonetheless spectacularly slow growth has definitely occurred in some of the Cadzow oaks. To suggest that this tree is 800 - 900 years old is not unreasonable.

Whatever the exact age of this tree it is apparent that many of the Cadzow oaks date from the 15th and 16th Centuries. Although planting of trees is not known to have been commonplace at this time it cannot be ruled out. If the trees are older than this then the likelihood of them being of natural origin as opposed to being planted increases significantly. Ultimately no firm conclusions can be drawn about events which occurred centuries ago.

Some of the wood is undoubtedly secondary in nature since some of the trees are clearly growing on old earthworks which have the appearance of the remnants of ridge-and-furrow cultivation. The furrows are quite widely spaced (about 6m) and the lines of the furrows do not run straight. This is characteristic of mediaeval or older ridge-and-furrow, more recent cultivation being narrower and straighter. The furrows at Cadzow have a slight curve. The trees which are in this area stand proud on top of the ridges and the furrows indicating that they are chronologically later than them. This would not be so likely if the furrows skirted individual trees.

What then of the legend concerning David I? It has been shown that the present trees are possibly old enough to have been planted in the 12th Century or indeed they could be the natural successors of trees which were. Firm conclusions cannot be drawn and the position is well summed up by Boyd Watt (1910) (page 14): "Traditions such as these which assert that the old Oaks of Cadzow forest were planted by David, Earl of Huntingdon, afterwards David I (1124 - 1153), ... seem to be supported only by constant repetition not by any proof or certainty."

PAST MANAGEMENT AND CHANGES

A study of old maps, old documents and of the trees themselves can provide much information about how the trees have been managed in the past, how their numbers have altered and what changes there have been in the overall extent of the wood pasture.

Old Maps

Bleau's atlas has already been referred to and it provides evidence of the wood's presence in 1600. However it provides more information than simply the existence of the wood. The extent of the woodland at Cadzow is worth noting. By and large it corresponds to the furthest extents of the park as shown on later maps. It is significant that it is shown as being on the far side of the Meikle Burn in an area that is now a housing development within the town of Hamilton. Apart from one possible exception there are no longer any ancient oaks here. Moreover the trees extend across the Avon as far as a clearly marked boundary. No remnants of this area of woodland on the far side of the river can be found today.

Chronologically the next significant map is that of general Roy from the mid 18th Century (*The Military Survey of Scotland 1747 - 1755*). The trees are not shown as covering such a large area as in Blaeu's map. In particular there is no indication that they extend across the Avon to its eastern side.

A new feature appears in Roy's map. This is a boundary around the general area of the trees, although they do not grow out as far as it. Whether this represents the actual construction of such an enclosure, or simply a representation of a feature that was always there but not always shown, is a matter for speculation. The presence of this boundary would suggest that the area is now a true "park" i.e. an enclosed area of wooded or open land in which cattle or deer were kept for the purpose of hunting. This boundary roughly encompasses the area shown as being wooded on Blaeu's map and the fact that the trees do not fill the area may mean that some of the trees had been removed by the time of Roy's survey.

By the time of the first Ordnance Survey maps the area of the park has not altered greatly. The First Edition 6 inch: 1 mile map of 1864 (surveyed in 1858) shows the trees covering an area of 304 ha, which seems to be similar to Roy's map although there is the definite suggestion that the trees are now much thinner within the overall confines of the park.

The modern Ordnance Survey maps now show the trees covering approximately 90 hectares and the density of the trees again much reduced. There has been the extension of the farms and towns into the park. Nonetheless the ancient oaks, or "old oaks" as marked, seem to have survived this period of 100 years more or less intact and they are still to be found as a named feature on these maps. Aerial photographs confirm the changes in tree density which have occurred in the last 50 years. These recent changes and the implications for the conservation of the old oaks will be discussed more fully in a future paper (see also Dougall and Dickson 1997).

Historical documents and estate records

These trees have long since been noted as unusual and have been commented on for centuries. The earliest clear reference found to the trees is from 1667 when Sir John Lauder, visiting Hamilton Park, says (Crawford 1900, page 186): "Then went to the wood, which is of a vast bounds, much wood of it is felled; their being great oaks in it yet; rode through the lenth of it, it is thought to be 5 miles about." They are mentioned again shortly afterwards by Gibson (1695) but fuller descriptions are not made until the end of the 18th century when Naismith writes in the *Old Statistical Accounts of Scotland* (1791 - 1799). His description could almost have been written in modern times. He says that they "have always been regarded as a curiosity" and comments on their size: "some of them measuring upwards of 27 feet round". He notes that "they have been much diminished in point of number" and that "..... many of those that remain, having lost their tops and fine spreading boughs, are now only mutilated trunks, covered with short scrubby branches, still exhibiting the previous remains of their former grandeur."

The *New Statistical Account of Scotland* (1845) also describes the trees although in less detail. Most significant here is that one of the trees ("the boss tree") measures 36 feet in circumference. Moreover the author of this Account states: "Some of the trees are English oaks, supposed to have been planted by King David, first Earl of Huntington, about the year 1140." This may be where the local belief stems from. These references to the trees thus make mention of their striking appearance and the decline in their numbers.

Many of the estate records of the Duke of Hamilton's Estate on which these trees formerly stood still survive and they are obviously written from a totally different viewpoint. The "old oaks" are clearly referred to and they were obviously viewed as a valuable asset.

It is clear from a study of these documents that their *raison d'etre* was as an integral part of the chase, where wild white cattle or sometimes deer were allowed to roam. The area was protected from grazing animals and there are specific instructions listed to maintain the "dyke of the chace" (Hutton 1736), also Wright (1740), Burrell (1801). These oaks were also used as a source of timber e.g. for ships (Hutton 1736) and the bark was used for the tanning of leather; yet despite these other uses it seems clear that their primary importance on the estate was as part of the chase.

Ringwidth analysis

It is possible that the Cadzow oaks may have been managed in the past by a system of pollarding. In 1989 Keith Kirby visited the site for the Nature Conservancy Council and it was his belief "that the trees have been managed in part by pollarding in the past" (unpublished NCC report). This belief is common in the area and was published in a Hamilton District Council Guide to Chatelherault Country Park (1988). This method of obtaining wood from trees in the presence of grazing animals was undoubtedly practised in some English parks and forests e.g. Hatfield Forest (Rackham 1989). It is postulated by some that such a practice at Cadzow would account for the present shapes and growth habits of the trees.

If pollarding had been practised then a record of this will exist in the annual rings of the trees. The width of the annual ring reflects the overall amount of growth of the tree during that year and so can be used to infer environmental and local conditions controlling growth e.g. weather conditions, caterpillar defoliations etc. The science of dendrochronology depends upon the interpretation of such annual rings. In his study of Hayley Wood, Cambridgeshire, Rackham (1975) describes a damage cycle that results from plagues of the tortix-moth caterpillar (*Tortrix viridiana* L.). For a ten year period from 1916 onwards the average overall increase in girth was only 1.25cm.

If a tree is pollarded then this should be discernible in much the same way as described above for the defoliating effects of caterpillars. Rackham describes a sudden drop in ringwidth followed by a gradual recovery in some large oak trees growing in Hatfield Forrest, Essex (Rackham 1989). A smaller decrease is described by Rasmussen (1990) in ash trees. Experimentally pollarded trees showed a 58% decrease in ringwidths compared with a 5% drop in controls. Graphs which show changing ringwidths over a period of time make this pollarding highly apparent (Rasmussen, 1990).

Using data collected by Professor Mike Baillie of Queen's University, Belfast, (unpublished data, see also Baillie 1982) an analysis of ringwidths was carried out. In total there is data for 37 of the Cadzow trees (either from cut stumps or from living trees) and graphs were plotted to show the change in ringwidth over time. One such graph is shown in Figure 2. The graphs all showed a very similar picture. Their most obvious feature is that the ringwidths fluctuate considerably from year to year. This is to be expected since environmental factors also flucuate considerably. But significantly there is very little pattern among the trees and no instances of a large drop in ringwidth followed by a steady recovery, even when the growth of different trees at a particular time is compared.

The lack of such instances provides strong evidence of a general absence of pollarding. Moreover in any possible case there are numerous possible other explanations for the drop in ringwidth e.g. defoliation by caterpillars, fungal attack etc.

The management practice for Cadzow clearly was not as implied by Kirby. In woods such as Epping Forest (Rackham 1980) there was a sustained and systematic programme of pollarding the trees. Analysis of the annual rings produced over the last 548 years by these 37 trees shows that this simply was not the management practice at Cadzow in the period since 1444.

It can be concluded that the remarkable shape of these trees is primarily due to their considerable age and the repeated dieback and regrowth of their crowns in response to the countless changes in conditions which they have encountered over the centuries.

Table 1 summarises the history of the trees.

Table 1 History of the Cadzow Oaks

Pre 1100	area part of Scotland's natural woodland(?)
1100-1200	possible germination of one of the existing trees: legendary time of planting of the oaks by David I
1444	oldest dated oak began growing (died in 1855 but stump remains)
1596	large area of trees surveyed by Timothy Pont and marked on Blaeu's atlas (1658)
1667	first clear written record of the trees: "then went to the wood, which is of a vast bounds, there being great oakes in it yet; rode through the lenth of it, it is thought to be 5 miles about"
1695	reference to tall oaks here
1700-1800	Hamilton Estate records show that the oaks were protected in an enclosure, some wood from the damaged trees was used for fencing, for charcoal and for tanbark but the area was primarily maintained as a chase
1732-1744	Chatelherault built as a hunting lodge for James, 5th Duke of Hamilton
1791	description in *Old Statistical Accounts of Scotland*, the trees being noted as old, very large and already something of a curiosity; one tree said to be 27 feet in girth
1845	description in *New Statistical Accounts of Scotland*, one tree said to be 36 feet in girth
1858	area of park c.760 acres, the actual spread of the trees being similar to that in 1946 (when aerial photographs become available) although the most outlying trees had been removed by 1946
1946-1965	steady removal of trees from parts of the estate
1978	Chatelherault Country Park created from part of the estate together with a section of the Avon gorge; a small number within the boundary of the Country Park, most in Hamilton High Parks, sold to Mr Robert Wiseman
1952, 1971, 1984	Avon gorge and most of old oaks in areas notified as Sites of Special Scientific Interest
1979	11 old oaks known to have been cut by Mr Wiseman, Tree Preservation Order then imposed
1981	Voluntary Agreement protecting the oaks signed between Mr Wiseman and the NCC
1981 - 1996	no significant change in the number or state of the trees although one or two have been severely damaged or have died as a result of vandalism
1997	oak seedlings, raised from acorns of the Cadzow oaks, planted among them

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*MANUSCRIPT MATERIALS are unpublished papers of the Hamilton Estate. These are mostly held in Hamilton Library; transcripts of many are also held at Chatelherault Country Park.

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ALGAL COMMUNITIES IN GLASGOW STREAMS POLLUTED BY DOMESTIC SEWAGE EFFLUENT

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INTRODUCTION

The impact of nutrient enrichment on the changing biotic nature of running waters is well documented and has been shown to be important in the distribution of aquatic algal communities (Denisegar, Austin & Lucey, 1986; Leland & Carter, 1985; Round, 1981; Whitton, 1975). The present study formed part of a wider examination of the effects of pollution, on the plant and animal communities in streams North of the Glasgow conurbation (Turner & Barr, 1989).

This study compares the seasonal changes in structure of the natural algal communities at contrasting polluted and unpolluted sites on two streams. Communities are described using a species diversity index. Species richness and chlorophyll a are estimated for phytoplankton, epilithon (= on the surface of stones) and epiphyton (= on the surface of plants). Differences in community structure between the four sites are related to water quality parameters, particularly with respect to pollution.

DESCRIPTION OF SITES

Glazert water is 9.5km long and rises at Haughhead (Figure 1). It flows in a southerly direction to join the Kelvin upstream of Kirkintilloch. Pollution in the Glazert Water arises from the Lennox Castle Hospital, which discharges an organically rich effluent. Nailworks Burn, which joins the Glazert Water about 4km from its source has high levels of ammonia, chloride and especially iron which contributes to the pollution of the Glazert Water downstream. It is also polluted by acid pickle rinse water. The Glazert Water was sampled at two sites, upstream of the Nailworks Burn (GW1) (National Grid reference, NGR NS 619 783) and downstream (GW2) (NGR NS 633 771).

The Allander Water is 13km long and flows off the Kilpatrick Hills in a South-easterly direction to join the Kelvin below Milngavie. The major cause of pollution in this river is the discharge from Milngavie sewage works. The Allander Water was sampled at an upstream site 8km from the sewage works (AW1) (NGR NS 538 768) and at a polluted site (AW2), 2km below the source of pollution (NGR NS 575 729). Table 1 presents information on the catchment area and discharge for the two streams covering the period of study.

MATERIALS AND METHODS

Samples were taken monthly from October 1984 to June 1986. On each occasion temperature and dissolved oxygen were recorded. Sampling was done simultaneously and between 9.00-10.00 a.m. covering a distance of 20km. Water samples for chemical analysis and plankton quantification were collected in 1 litre polythene bottles. Immediately on return to the laboratory, pH was recorded and 5 day Biological Oxygen Demand incubations set up. Water for chemical analysis was filtered through Whatmans GF/C glass microfibre filters, and analyses of nitrate, ammonia, phosphate and silicate were all completed on the day of sampling. Analytical techniques followed those of MacKereth *et al.* (1978). Samples of stone and vegetation for measurement of epilithic and epiphytic communities were taken and transported to the laboratory in wide mouth glass jars. At all sites the bed of the stream was stony. Preliminary studies of the epipelic algal community using the sampling method of Eaton & Moss (1967) and Happey-Wood *et al.* (1988) showed it to be negligible and the algal productivity rate low: therefore it was not sampled further.

Phytoplankton samples were concentrated by sedimenting 1 litre of water in a measuring cylinder. After the supernatant had been removed the residue was made up to 25ml and sedimented again in a counting chamber for enumeration and species identification under a Zeiss inverted microscope. Results are expressed as cells l^{-1}. Epilithic algae were carefully scraped from $30mm^2$ area of stone in triplicate. The slurry thus produced was made up to a known volume, carefully mixed and the cells in an aliquot counted using a compound microscope. Epiphytic algae were removed from the supporting vegetation with dilute HCl, following the method of Tippett (1970). Identifications were according to Desikachary (1959), Anagnostidis & Komarek (1990), Hustedt (1930), Lind & Brook (1980) and Prescott (1951). Species diversity was calculated according to Shannon & Weaver (1949) from Log_{10} data, species richness according to Margalef (1958) and a qualitative comparison of the species composition of the four stations was made using Jaccard's coefficient of similarity (Morgan, 1987).

The measurements of chlorophyll *a* for each community were made following the recommendations of Riemann (1980) and Marker *et al.* (1980). Water samples were taken from four sites of Glasgow streams (AW1, AW2, GW1 and GW2), and the pigment analyses were performed on the same day. The plankton from 1 litre of water was concentrated by filtration onto Whatmans GF/C microfibre filter; the slurry scraped from a $30mm^2$ area of stone was used for the epilithic community and epiphytes were removed ultrasonically using the method described in Tippett (1970). The ultrasonic treatment was found to be very efficient (85%) except for a few interfering detrital materials. Final volume was brought up to 10 ml before extraction with methanol. Chlorophyll was extracted in absolute methanol and acidification was carried out to obtain phaeopigment. Magnesium carbonate solution was used to neutralize the acid effect. A one hour extraction period was maintained throughout the study. The calculation of Lorenzen (1967) was used to obtain the values of chlorophyll *a* and phaeopigment, expressed as $\mu g\ l^{-1}$ for phytoplankton and cm^2 for epilithic and epiphytic algae.

Statistical analyses were performed using Minitab (Ryan *et al.* 1976). Product moment correlation was carried out between environmental variables as well as species diversity,

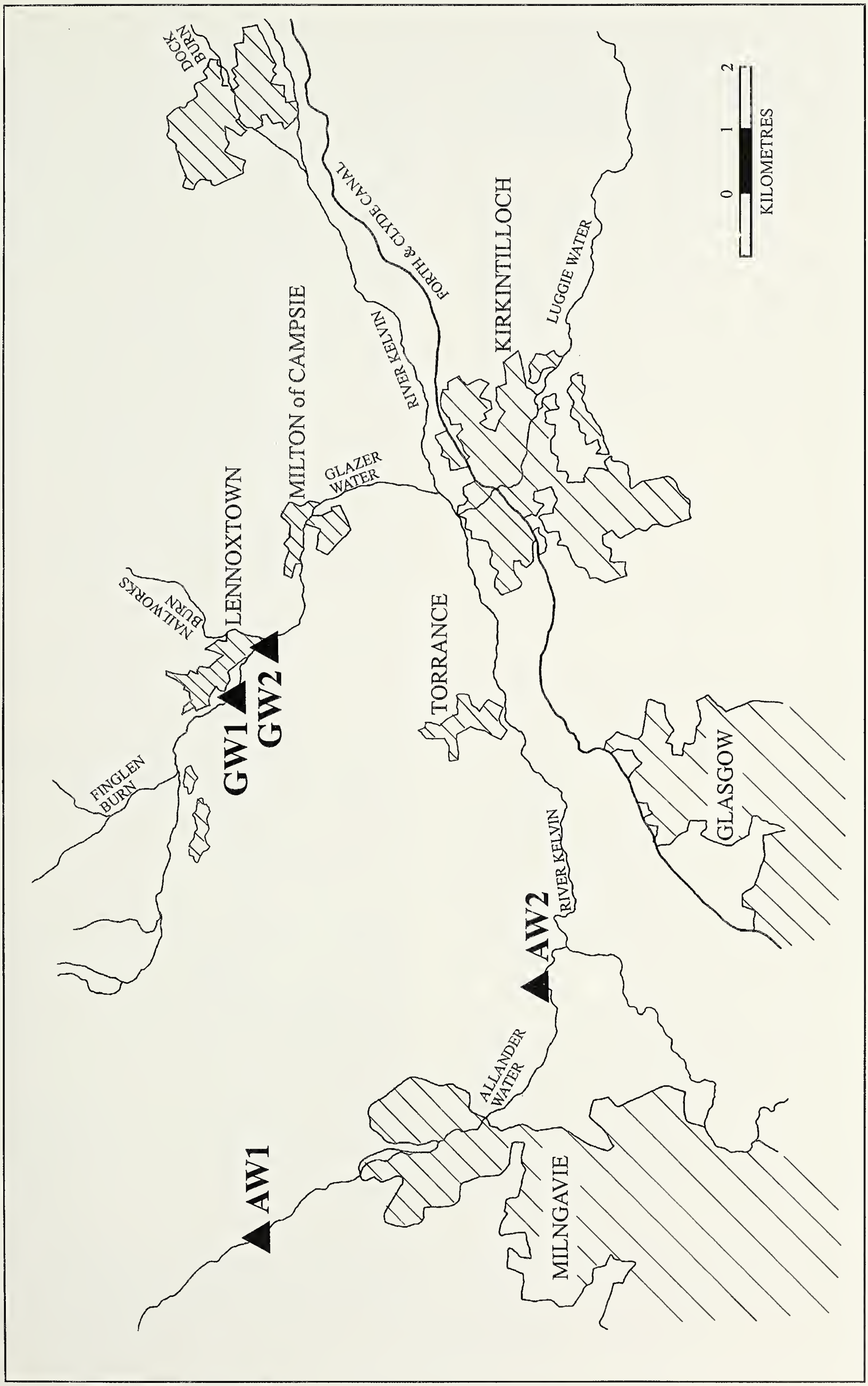


Fig. 1 Location map of sampling sites.

Table 1. Catchment area and flow characteristics of Allander Water and Glazert Water. AW1 is situated 8 km upstream and AW2 2 km downstream from the gauging station. GW1 is 2 km and GW2 1 km upstream from the gauging station

	Allander Water		*Glazert Water*	
	Discharge (m^3 sec^{-1})	**Mean water velocity (m sec^{-1})**	**Discharge (m^3 sec^{-1})**	**Mean water velocity (m sec^{-1})**
Long term average	1.2	0.36	1.7	0.025
Maximum recorded	53.8	8.3	71.2	6.47
Minimum recorded	0.006	0.005	0.05	0.02
1986 Values: average	1.8	0.54	2.5	0.37
maximum	45.2	6.9	54.1	4.9
minimum	0.062	0.05	0.141	0.06
Catchment area (km^2)	32.8		51.9	
Width of stream (m) at gauging station	6.3		8.6	

species richness and chlorophyll *a*. Multiple regression analysis was performed between all independent variables and chlorphyll *a* for phytoplankton, epilithic and epiphytic algae.

RESULTS

Environmental parameters

Temperature differences between stations were small, while seasonal variation was very marked, ranging from sub-zero temperature in winter to 14.5°C in summer. Allander Water pH ranged about neutrality with means of 7.14 and 7.03 respectively for AW1 and AW2, whereas Glazert Water was significantly acidic (pH means of 6.89 and 6.76 respectively for GW1 and GW2). In both streams pH was slightly more acidie in winter than in summer.

At the unpolluted sites AW1 and GW1, dissolved oxygen varied from minimum values of 7.5-9.5 to maximum values of 13.5-14.4 mg l^{-1}. At the polluted sites AW2 and GW2, dissolved oxygen was considerably reduced with values as low as 1.7-2.4 and maximum values of only 6.25-7.3 mg l^{-1}. At AW1 oxygen saturation was 90-100% throughout the period of sampling. At GW1 oxygen saturation was 90-100% throughout most of the study period but was reduced to 42-53% during the late summer of 1985. At AW2 and GW2 oxygen saturation was 40-50% in winter and fell to 16-23% in summer.

At the clean sites of AW1 and GW1 the mean values of Biological Oxygen Demand were 3.6-3.8 mg O_2 l^{-1} compared with downstream sites (AW2 and GW2) where BOD reached as high as 8.8-10.1 mg O_2 l^{-1}. BOD was strongly influenced by thermal conditions in both Allander and Glazert Waters.

Nitrate nitrogen concentrations at polluted sites (AW2 and GW2) were highest during winter, which may be due to leaching from farm land; and in the spring, prior to stream algal increase in unpolluted sites (AW1 and GW1). The decline through the spring and summer was gradual at all four sites, with the lowest concentrations being recorded in late July. The rise in nitrate over the winter corresponded to minimum biological activity and maximum flow rates (Fig 2a). Increase or decrease of nitrate did not show any correlation with oxygen saturation, but showed a distinct inverse correlation with orthophosphate concentration.

The ammonia nitrogen concentration remained low at AW1 throughout the sampling period (range 18-96μg l^{-1}) with only a small increase in spring (Fig 2b). At AW2, ammonia concentration was very much higher (range 77-1860μg l^{-1}) with a very rapid increase in March of each year followed by a moderately slow decline throughout the summer. This peak was associated with the onset of a decline in oxygen and nitrate concentrations which provide evidence that although most of the ammonia must have originated directly from allochthonous sources (such as increased sewage flow and defoliation from the surrounding areas), some resulted from bacterial reduction of nitrate. The ammonia concentration in GW showed a similar seasonal pattern at both sites, and was roughly similar to AW2, although the seasonal pattern was not so clearly shown.

In both Allander and Glazert Waters (Fig 2c), silica concentrations followed a cyclic seasonal distribution, with high winter values being reduced in spring followed by a gradual increase in summer and a moderate decline in autumn before recovering in winter.

Orthophosphate phosphorus in Allander and Glazert Waters (Fig 2d) was low in winter (10-25 μg^{-1}), but increased steadily to a maximum in summer (55-107 μg l^{-1}). Autumnal orthophosphate content was low in GW1, moderate in AW1 and GW2 and high in AW1.

Algal communities of Allander and Glazert Waters

A total of 106 species of algae was recorded during the course of the 21 months investigation (Table 2). The greatest species richness was shown by diatoms (58), followed by Chlorophyceae (20), Cyanophyceae (15), Chrysophyceae (6), Euglenophyceae (4), Dinophyceae (3) and Cryptophyceae (2). Filamentous Chlorophyceae, viz. *Oedogonium*, *Stigeoclonium* and *Cladophora* were the main contributers to chlorophyll *a* in these communities.

Jaccard's coefficient showed high similarity between algal communities. A comparison between different stations indicated greatest similarity between Allander Waters (AW1 and AW2) and between Glazert Waters (GW1 and GW2). A lower similarity was observed when all four stations were compared.

Phytoplankton community The algal flora of this community was very similar to the epiphytic and epilithic flora. Motile Chlorophyceae, such as *Chlamydomonas*, *Platymonas*, *Pteromonas*, *Carteria* and *Gonium* were present in AW1 and AW2 and GW1 during late spring and in October, but totally

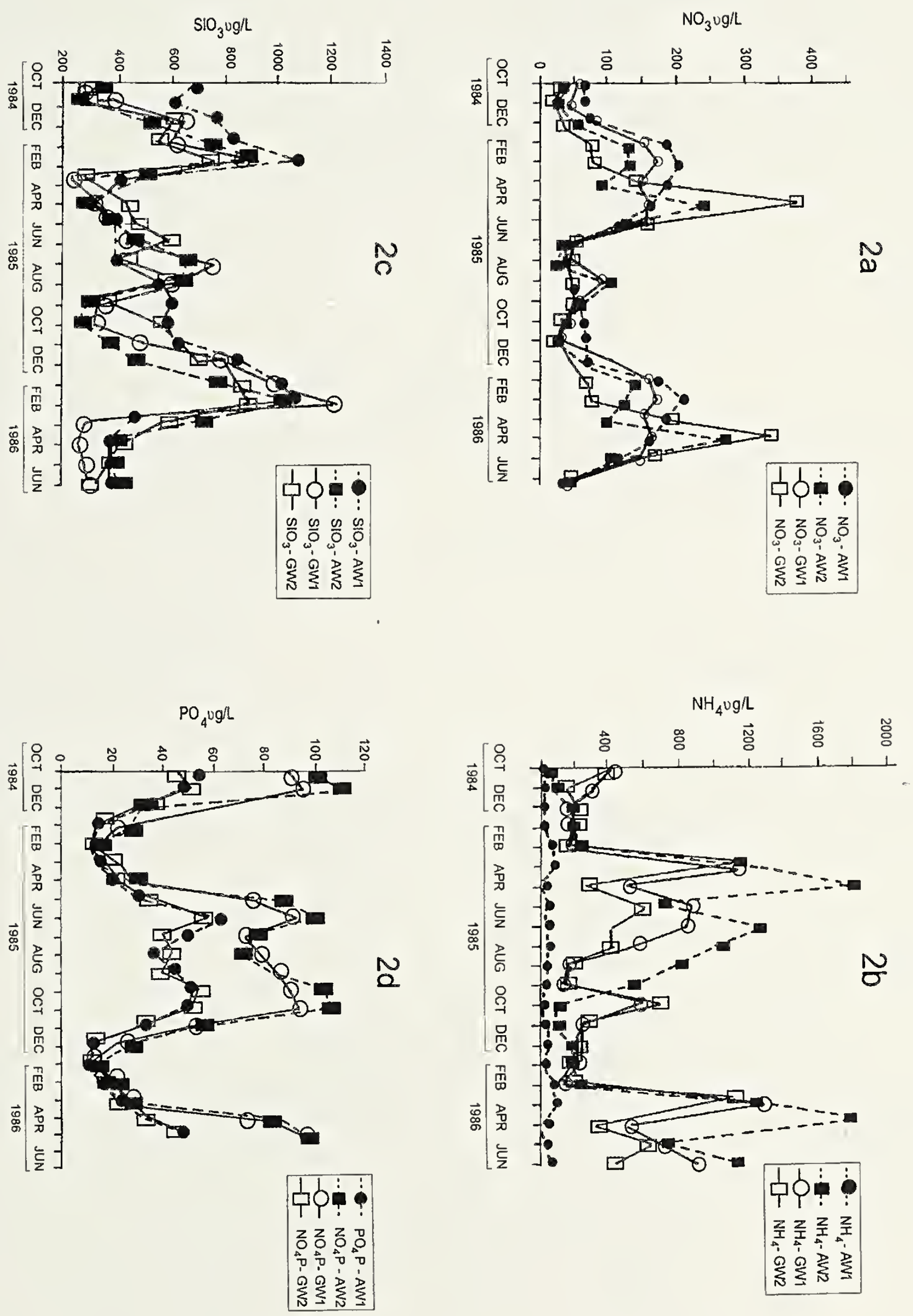


Fig. 2 Monthly records at the four sites (AW1 & 2; GW1 & 2) for a) nitrate, b) ammonia, c) silica and d) phosphate.

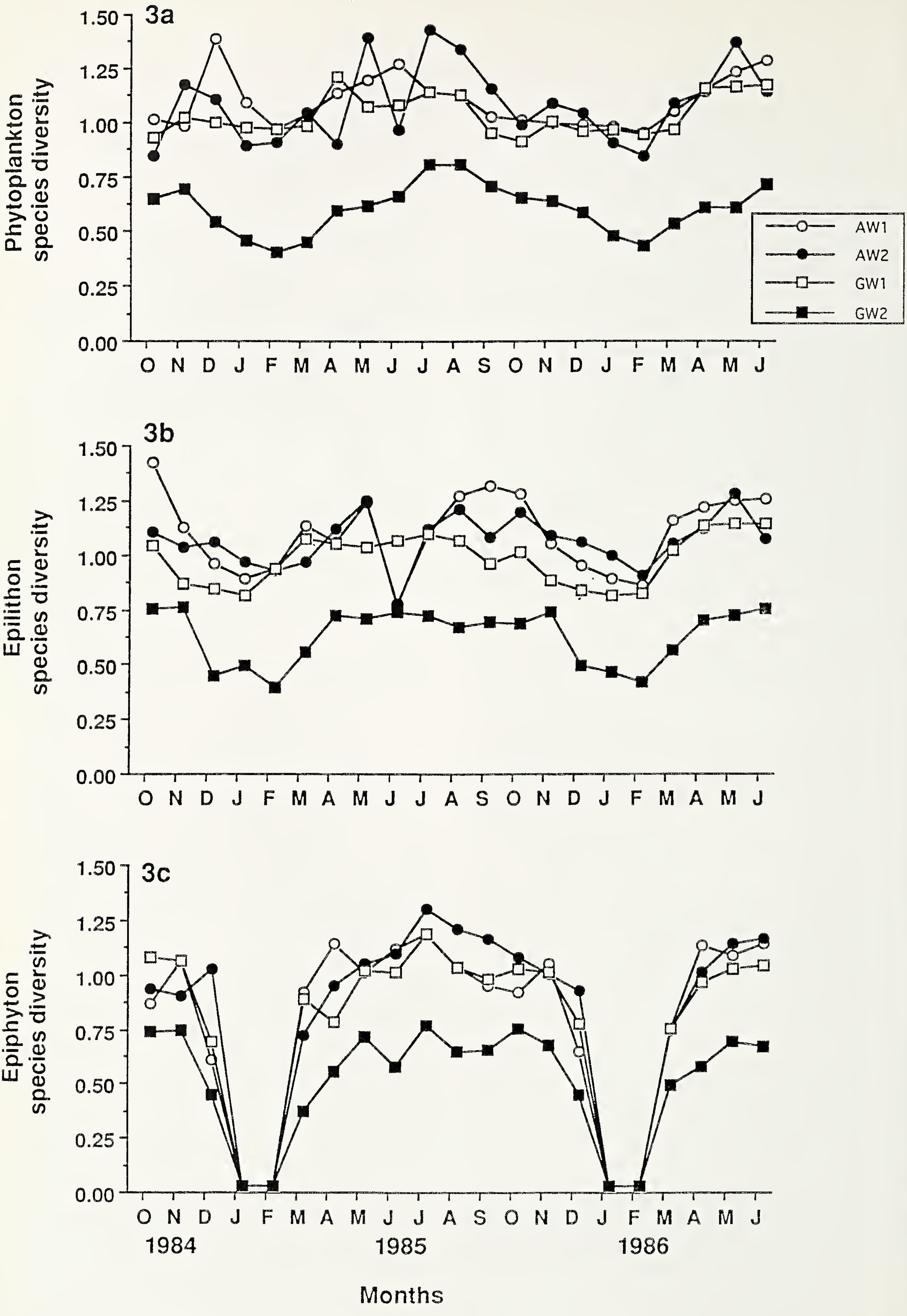


Fig. 3 Monthly records at the four sites (AW1 & 2; GW1 & 2) for species diversity: a) phytoplankton, b) epilithon and c) epiphyton.

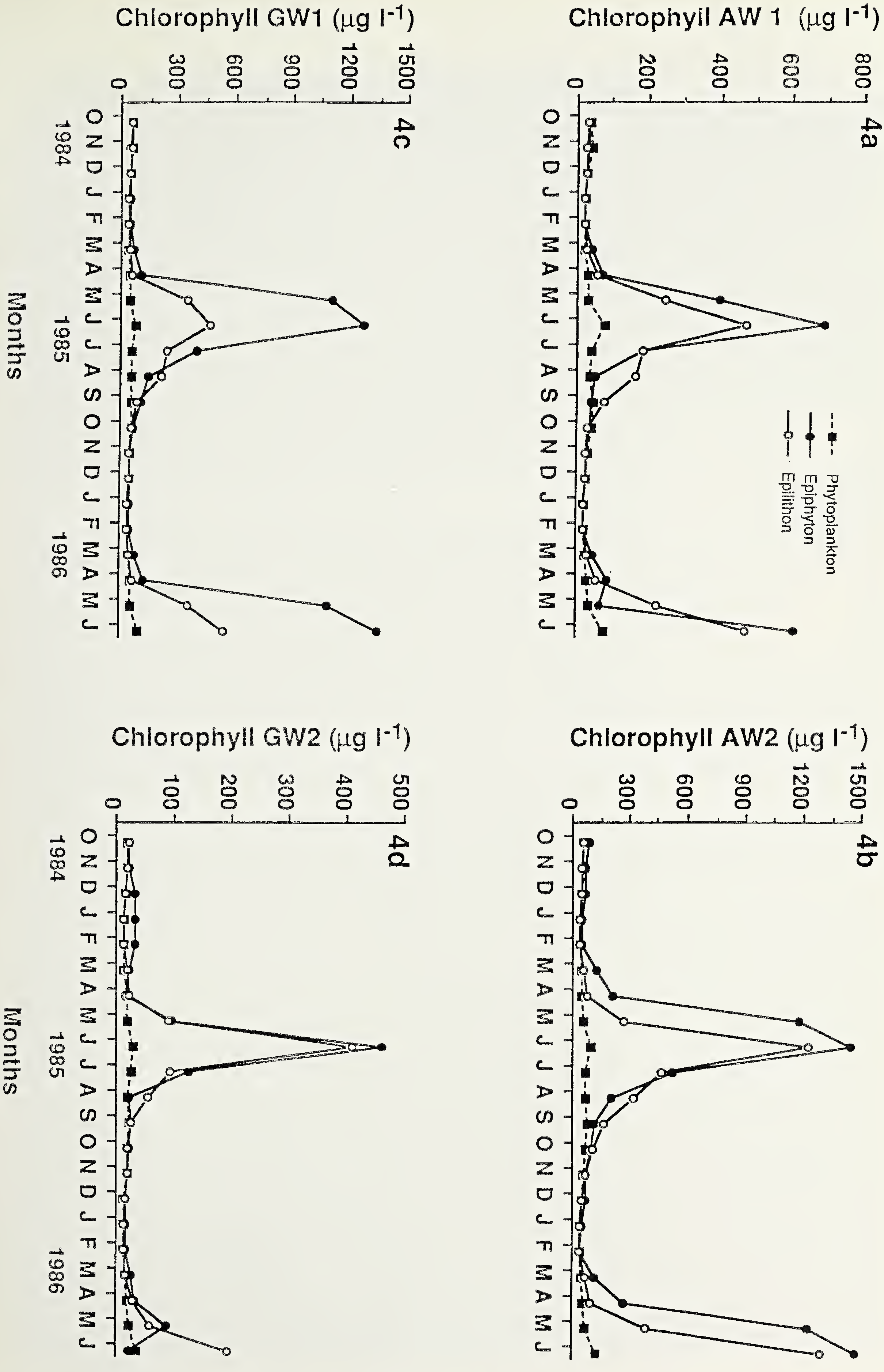


Fig. 4 Monthly records at the four sites (AW1 & 2; GW1 & 2) for chlorophyll in the three components: phytoplankton, epiphyton and epilithon.

Lime Seedling
Tilia x europaea 1997 seedling,
May, palmate cotyledons,
next leaves budding.

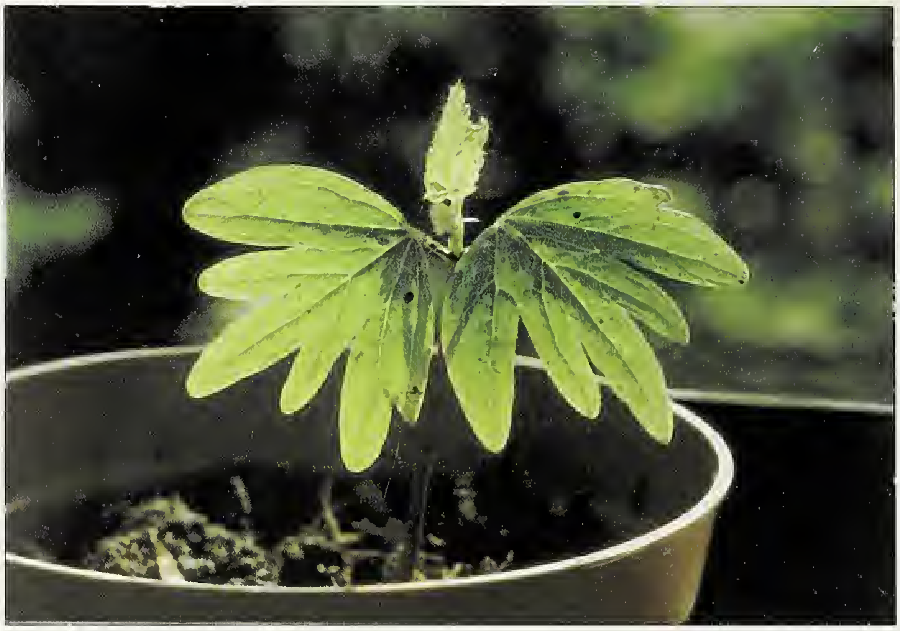


photo: Norman Grist

Lime Seedling
Tilia x europaea 1997 seedling,
July, one cotyledon remains,
next true leaves neither
palmate or cordate

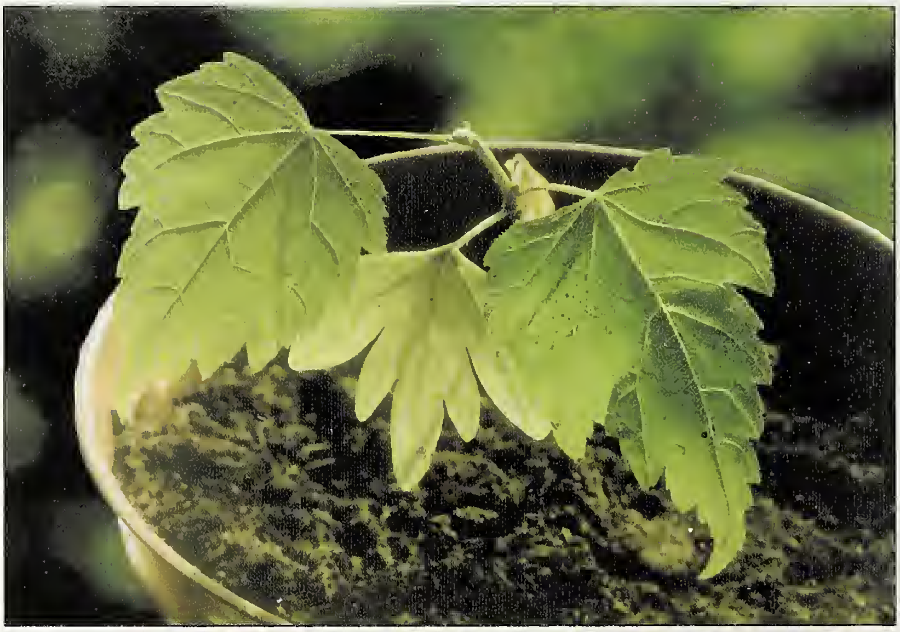


photo: Norman Grist

Barklouse
Graphopsocus cruciatus
A common Lothain's Barklouse.

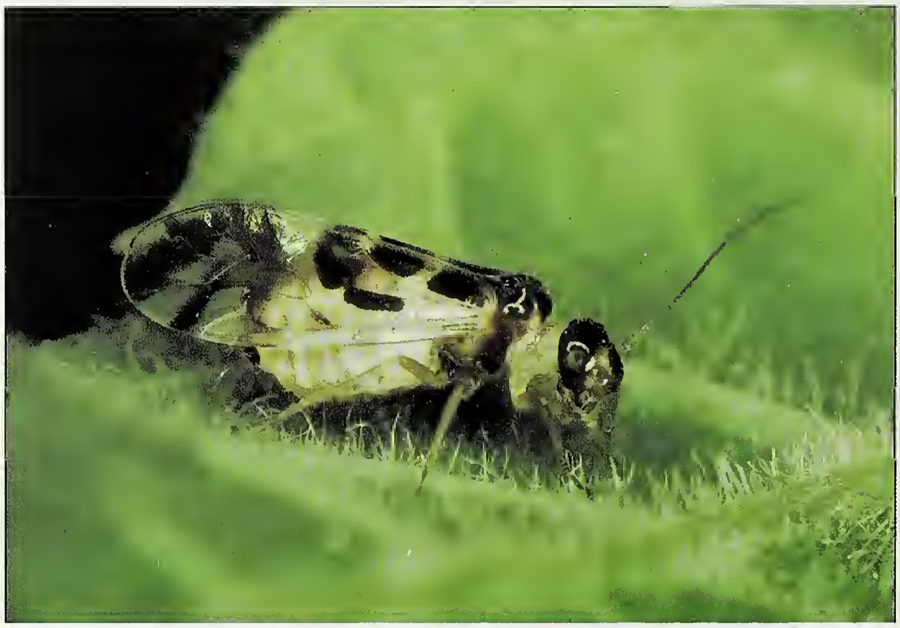


photo: B. Knoflach

B

A

C

D

E

F

Table 2. List of algal species recorded in Allander & Glazert Waters of River Kelvin between October 1984 and June 1986.

Taxon	Site AW1	 AW2	 GW1	 GW2
Bacillariophyceae				
Centrales				
Melosira varians Ag.	+	+	+	+
M. italica Roth	+	+	+	
M. crenulata Kutz.	+		+	
M. granulata (Ehr.) Ralfs	+	+	+	+
Cyclotella comta (Ehr.) Kutz	+	+	+	+
C. meneghiniana Kutz.	+	+		
C. stelligera Cl. & Grun.	+		+	
Stephanodiscus astraea (Ehr.) Grun.	+	+	+	+
Pennales				
Tabellaria fenestrata var. *asterionelloides* Grun.	+	+	+	+
T. flocculosa (Roth) Kutz.	+	+	+	
T. binales (Ehr.) Grun.	+			
Asterionella formosa Hassall	+	+	+	
Fragilaria constuens (Ehr.) Grun.	+	+	+	+
Synedra ulna (Nit.) Ehr.	+	+		
S. acus Kutz.		+	+	+
Meridion circulare (Grev.) Ag.	+	+	+	+
Amphipleura pellucida Kutz.	+	+		
Navicula cuspidata Kutz.	+	+	+	+
N. elegans Wm. Smith	+	+	+	
N. cocconeiformis Greg.	+	+		
N. placentula (Ehr). Kutz	+	+	+	
Nitzschia linearis Wm. Smith	+	+	+	+
N. sigma (Kütz.) Wm. Smith	+		+	
N. denticula Grun.		+		
N. acicularis (Kütz.) Wm. Smith	+	+	+	
N. palea Grun.		+	+	
Hantzschia amphioxys (Ehr.) Grun.		+	+	
Eunotia exigua (Bréb) Rabh.	+	+	+	
Pinnularia divergentissima (Grun.) Ralf.	+	+	+	+
P. viridis Ag.		+		
P. stauroptera (Grun.) Rabh.	+	+		
Amphora ovalis Kutz.	+	+	+	+
A. veneta Kutz.		+	+	
Cymbella prostrata (Berk.) Brun.	+		+	
C. ventricosa Ag.		+	+	
C. hybrida Grun.		+	+	
Gomphonema acuminatum var. *coronata* Rabh.	+	+	+	+
G. intricatum Kutz.		+		
G. parvulum Kutz.		+	+	
Cocconeis pediculus Kutz.	+	+	+	+
C. diminuta Pant.			+	+
Caloneis silicula (Ehr.) Cleve	+	+		
Mastogloia smithii var. *lacustris* Grun.		+	+	+
Surirella biseriata Bréb.	+	+	+	+
S. ovata Kütz.	+	+		
S. ovata var. *pinnata* (Wm. Smith) Bréb.	+	+		
Achnanthes lanceolata (Bréb). Grun.	+	+	+	+
A. brevipes Ag.	+		+	
A. depressa (Cleve) Hust.	+		+	
Gyrosigma kutzingii Grun.	+	+	+	+
Rhoicosphenia curvata (Kutz.) Grun.	+	+	+	
Stauroneis prominula (Grun.) Hust.	+	+	+	
Denticula tenuis Kütz.		+	+	
Epithemia cistula Ralfs.	+		+	
Diatoma hiemale (Lyng.) Heiberg	+		+	
Ceratoneis arcus (Ehr.) Kütz.	+	+	+	+
Cyanophyceae				
Coelosphaerium kuetzinghianum Nag.	+	+	+	+
Stichosiphon regularis Geit.	+		+	+
Oscillatoria agardhii Gom.	+	+		+
Oscillatoria sp.	+		+	
O. limnetica Lemm.	+	+		
O. splendida Grev.	+			
Leptolyngbya fragilis (= *Phormidium fragile*) Gom.				+
Raphidiopsis curvata Fritsch	+		+	
Anabaena spiroides Kleb.			+	
A. inequalis (Kütz.) Born et Flah	+		+	
Scytonema sp.			+	+
Leptolyngbya gloeophila (=*Plectonema gloeophilum*) Borzi			+	+
Anabaenopsis circlaris (G.S. West) Wolosz and Miller	+			
Spirulina major Kütz.	+		+	
Pseudanabaena arcuata (=*Phormidium arcuata*) Skuja			+	
Chlorophyceae				
Chlamydomonas sp.	+	+	+	
Platymonas sp.				
Pteromonas sp.	+	+	+	
Carteria sp.	+	+		
Gonium sp.			+	
Scenedesmus sp.	+	+	+	+
Closteriopsis longissima Lemm.	+	+	+	+
Closterium moniliforme (Bory) Ehr.	+	+	+	+
C. acutum var. *variabile* (Lemm.) Krieg.	+	+	+	
C. cornu Bory	+	+	+	
Staurastrum capitulum Breg.				
S. cingulum (W & G.S. West) G.M. Smith	+	+	+	
Cosmarium costatum W & G. S. West	+	+	+	+
Netrium sp.			+	
Hormidium sp.	+	+		
Oedogonium sp.	+	+	+	+
Mougeotia sp.	+	+	+	
Stigeoclonium sp.	+	+		
Microthamnion sp.	+	+		
Cladophora sp.	+	+	+	
Euglenophyceae				
Euglena acus Ehr.	+		+	+
E. limnophyla Lemm.		+		
Phacus onyx Pochmann			+	
Trachelomonas hispidata Lemm.	+		+	+
Dinophyceae				
Peridinium sp.			+	
Gymnodinium sp.			+	
Ceratium hirundinella Bergh.	+	+		
Chrysophyceae				
Ochromonas sp.	+		+	
Synura sp.	+	+	+	+
Mallomonas sp.	+			
Chrysococcus sp.	+			
Bumilleriopsis sp.	+			
Dinobryon divergens Imhof	+		+	
Cryptophyceae				
Cryptomonas sp.	+	+	+	+
Rhodomonas sp.		+	+	

absent from GW2. On the other hand, euglenoids (*Euglena acus, Phacus onyx* and *Trachelomonas hispidata*) were present in AW2 and GW2 and with the exception of *Euglena limnophyla*, absent from AW1. *Cryptomonas* was unique to the phytoplankton and was found at all four stations. Blue-green algae, particularly *Oscillatoria* sp., *Coelosphaerium kuetzingianum and Anabaena inequalis* were abundant in the spring bloom and again in late autumn. Diatoms were found at all four stations, and a significant number of species shared community similarity with epiliths and epiphytes. *Stephanodiscus*, *Cyclotella* and *Melosira* were recorded as plankton only at times during summer. They were also found mixed with epiphytic and epilithic algae during late summer and autumn.

The species diversity was calculated from Log_{10} data for each algal community at each site (Fig 3a). Diversity ranged between 0.8 and 1.4 at all sites except GW2, where the range was 0.4 to 0.8. In all cases diversity was higher in summer than in winter, although this pattern was less clearly seen at GW1.

The phytoplankton species richness showed the number of species to vary from 15 to 42 and all four stations showed uniform summer maxima. The plankton estimated as chlorophyll *a* was lower than that of the epilithic and epiphytic algal communities (Fig 4). The chlorophyll degradation

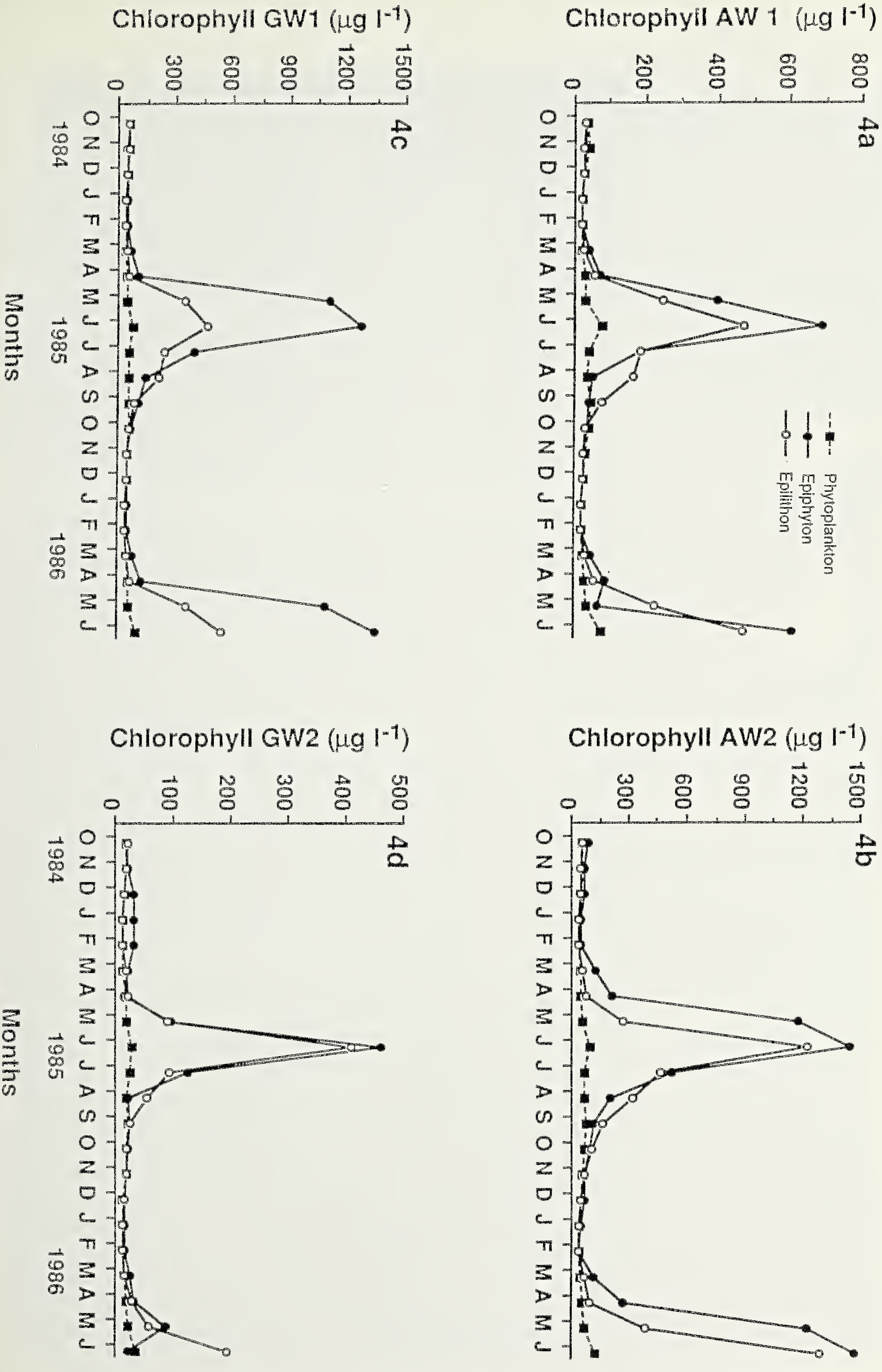


Fig. 4 Monthly records at the four sites (AW1 & 2; GW1 & 2) for chlorophyll in the three components: phytoplankton, epiphyton and epilithon.

Lime Seedling
Tilia x europaea 1997 seedling,
May, palmate cotyledons,
next leaves budding.

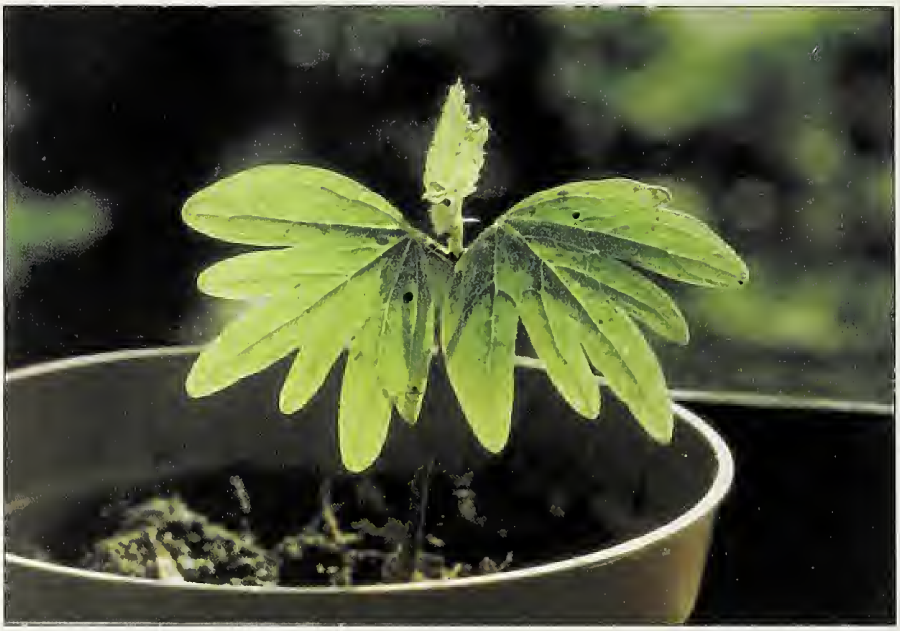


photo: Norman Grist

Lime Seedling
Tilia x europaea 1997 seedling,
July, one cotyledon remains,
next true leaves neither
palmate or cordate

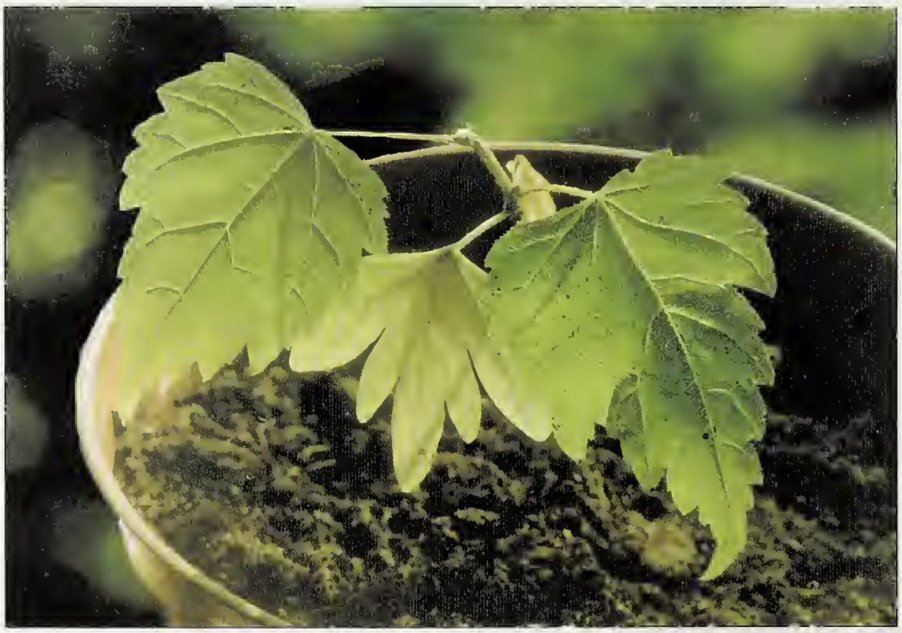


photo: Norman Grist

Barklouse
Graphopsocus cruciatus
A common Lothain's Barklouse.

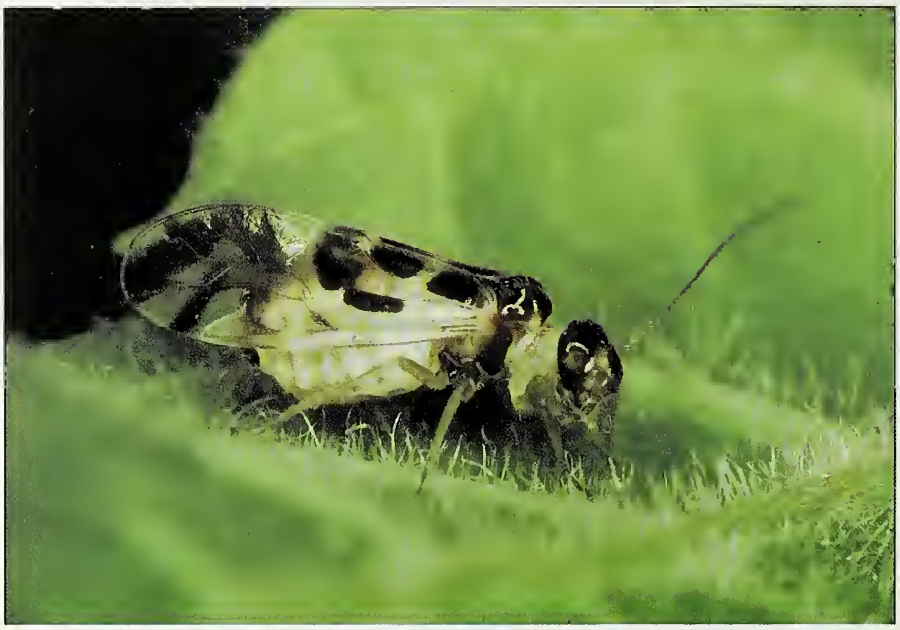
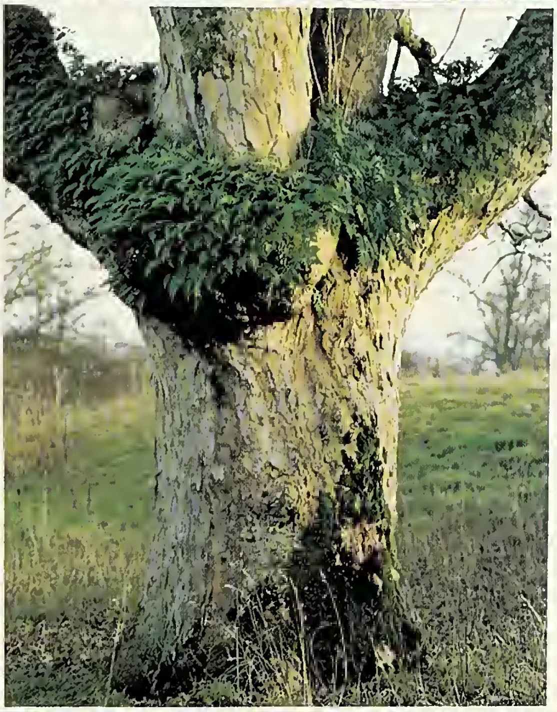


photo: B. Knoflach

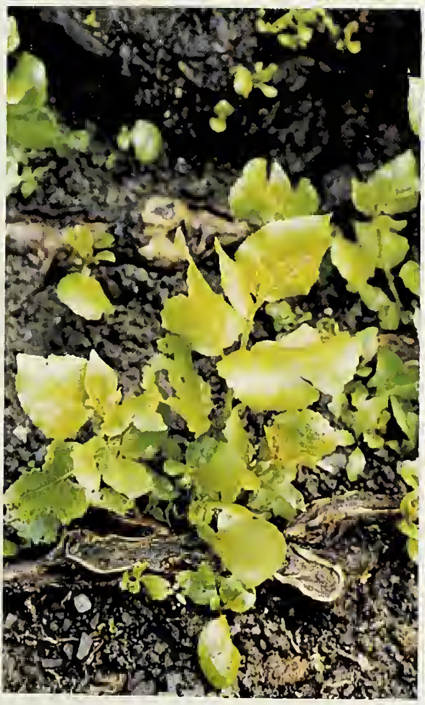
B

A

C



D



E

F

Table 2. List of algal species recorded in Allander & Glazert Waters of River Kelvin between October 1984 and June 1986.

Taxon	**Site**			
	AW1	AW2	GW1	GW2
Bacillariophyceae				
Centrales				
Melosira varians Ag.	+	+	+	+
M. italica Roth	+	+	+	
M. crenulata Kutz.	+		+	
M. granulata (Ehr.) Ralfs	+	+	+	+
Cyclotella comta (Ehr.) Kutz	+	+	+	+
C. meneghiniana Kutz.	+	+		
C. stelligera C1. & Grun.	+		+	
Stephanodiscus astraea (Ehr.) Grun.	+	+	+	+
Pennales				
Tabellaria fenestrata var. *asterionelloides* Grun.	+	+	+	+
T. flocculosa (Roth) Kutz.	+	+	+	
T. binales (Ehr.) Grun.	+			
Asterionella formosa Hassall	+	+	+	
Fragilaria constuens (Ehr.) Grun.	+	+	+	+
Synedra ulna (Nit.) Ehr.	+	+		
S. acus Kutz.		+	+	+
Meridion circulare (Grev.) Ag.	+	+	+	+
Amphipleura pellucida Kutz.	+	+		
Navicula cuspidata Kutz.	+	+	+	+
N. elegans Wm. Smith	+	+	+	
N. cocconeiformis Greg.	+	+		
N. placentula (Ehr). Kutz	+	+	+	
Nitzschia linearis Wm. Smith	+	+	+	+
N. sigma (Kütz.) Wm. Smith	+		+	
N. denticula Grun.		+		
N. acicularis (Kütz.) Wm. Smith	+	+	+	
N. palea Grun.		+	+	
Hantzschia amphioxys (Ehr.) Grun.		+	+	
Eunotia exigua (Bréb) Rabh.	+	+	+	
Pinnularia divergentissima (Grun.) Ralf.	+	+	+	+
P. viridis Ag.		+		
P. stauroptera (Grun.) Rabh.	+	+		
Amphora ovalis Kutz.	+	+	+	+
A. veneta Kutz.		+	+	
Cymbella prostrata (Berk.) Brun.	+		+	
C. ventricosa Ag.		+	+	
C. hybrida Grun.		+	+	
Gomphonema acuminatum var. *coronata* Rabh.	+	+	+	+
G. intricatum Kutz.		+		
G. parvulum Kutz.		+	+	
Cocconeis pediculus Kutz.	+	+	+	+
C. diminuta Pant.			+	+
Caloneis silicula (Ehr.) Cleve	+	+		
Mastogloia smithii var. *lacustris* Grun.		+	+	+
Surirella biseriata Bréb.	+	+	+	+
S. ovata Kütz.	+	+		
S. ovata var. pinnata (Wm. Smith) Bréb.	+	+		
Achnanthes lanceolata (Bréb). Grun.	+	+	+	+
A.brevipes Ag.	+		+	
A. depressa (Cleve) Hust.	+		+	
Gyrosigma kutzingii Grun.	+	+	+	+
Rhoicosphenia curvata (Kutz.) Grun.	+	+	+	
Stauroneis prominula (Grun.) Hust.	+	+	+	
Denticula tenuis Kütz.		+	+	
Epithemia cistula Ralfs.	+		+	
Diatoma hiemale (Lyng.) Heiberg	+		+	
Ceratoneis arcus (Ehr.) Kütz.	+	+	+	+
Cyanophyceae				
Coelosphaerium kuetzinghianum Nag.	+	+	+	+
Stichosiphon regularis Geit.	+		+	+
Oscillatoria agardhii Gom.	+	+		+
Oscillatoria sp.	+		+	
O. limnetica Lemm.	+	+		
O. splendida Grev.	+			
Leptolyngbya fragilis (= *Phormidium fragile*) Gom.				+
Raphidiopsis curvata Fritsch	+		+	
Anabaena spiroides Kleb.			+	
A. inequalis (Kütz.) Born et Flah	+		+	
Scytonema sp.			+	+
Leptolyngbya gloeophila (= *Plectonema gloeophilum*) Borzi			+	+
Anabaenopsis circlaris (G.S. West) Wolosz and Miller	+			
Spirulina major Kütz.	+		+	
Pseudanabaena arcuata (= *Phormidium arcuata*) Skuja			+	
Chlorophyceae				
Chlamydomonas sp.	+	+	+	
Platymonas sp.				
Pteromonas sp.	+	+	+	
Carteria sp.	+	+		
Gonium sp.			+	
Scenedesmus sp.	+	+	+	+
Closteriopsis longissima Lemm.	+	+	+	+
Closterium moniliforme (Bory) Ehr.	+	+	+	+
C. acutum var. variabile (Lemm.) Krieg.	+	+	+	
C. cornu Bory	+	+	+	
Staurastrum capitulum Breg.				
S. cingulum (W & G.S. West) G.M. Smith	+	+	+	
Cosmarium costatum W & G. S. West	+	+	+	+
Netrium sp.			+	
Hormidium sp.	+	+		
Oedogonium sp.	+	+	+	+
Mougeotia sp.	+	+	+	
Stigeoclonium sp.	+	+		
Microthamnion sp.	+	+		
Cladophora sp.	+	+	+	
Euglenophyceae				
Euglena acus Ehr.	+		+	+
E. limnophyla Lemm.		+		
Phacus onyx Pochmann			+	
Trachelomonas hispidata Lemm.	+		+	+
Dinophyceae				
Peridinium sp.			+	
Gymnodinium sp.			+	
Ceratium hirundinella Bergh.	+	+		
Chrysophyceae				
Ochromonas sp.	+		+	
Synura sp.	+	+	+	+
Mallomonas sp.	+			
Chrysococcus sp.	+			
Bumilleriopsis sp.	+			
Dinobryon divergens Imhof	+		+	
Cryptophyceae				
Cryptomonas sp.	+	+	+	+
Rhodomonas sp.		+	+	

absent from GW2. On the other hand, euglenoids (*Euglena acus, Phacus onyx* and *Trachelomonas hispidata*) were present in AW2 and GW2 and with the exception of *Euglena limnophyla*, absent from AW1. *Cryptomonas* was unique to the phytoplankton and was found at all four stations. Blue-green algae, particularly *Oscillatoria* sp., *Coelosphaerium kuetzingianum and Anabaena inequalis* were abundant in the spring bloom and again in late autumn. Diatoms were found at all four stations, and a significant number of species shared community similarity with epiliths and epiphytes. *Stephanodiscus*, *Cyclotella* and *Melosira* were recorded as plankton only at times during summer. They were also found mixed with epiphytic and epilithic algae during late summer and autumn.

The species diversity was calculated from Log_{10} data for each algal community at each site (Fig 3a). Diversity ranged between 0.8 and 1.4 at all sites except GW2, where the range was 0.4 to 0.8. In all cases diversity was higher in summer than in winter, although this pattern was less clearly seen at GW1.

The phytoplankton species richness showed the number of species to vary from 15 to 42 and all four stations showed uniform summer maxima. The plankton estimated as chlorophyll *a* was lower than that of the epilithic and epiphytic algal communities (Fig 4). The chlorophyll degradation product, phaeopigment, constituted only 16-26% among the phytoplankton community. The chlorophyll *a* content followed a characteristic pattern with winter minima, summer maxima and a gradual decline in autumn before returning to a second winter minimum.

Epilithic community The filamentous Chlorophyceae, *Oedogonium, Stigeoclonium, Microthamnion* and *Cladophora*, the majority of pennate diatoms and *Dinobryon divergens* were all representative forms of this community. The distribution of *Oedogonium* in AW2 was overwhelming, outcompeting all other algae and producing higher chlorophyll *a* values during summer months. The mean value of the epilithic species diversity (Fig 3b) was lower than that of the phytoplankton but higher than that of epiphytic algae. Allander Water (AW1 and AW2) was higher than Glazert Water (GW1 and GW2) with the maxima during June and July in both 1985 and 1986. The species richness of epilithic algae was intermediate between those of phytoplankton and epiphytic algae, with the maximum during summer months.

Chlorophyll *a* (Fig 4) was higher due to the predominance of *Oedogonium*, which contributed a three to four fold increase during summer. Phaeopigment was also higher (26-39%) in the epilithic community. The collapse of the summer bloom observed in July 1985 was caused by unusually high rainfall around the Glasgow area bringing an enormous influx of suspended solids and humic substances which increased turbidity.

Epiphytic community The algal flora represented in this community was collected from the surface of aquatic macrophytes, *Fontinalis, Ceratophyllum, Potamogeton crispus* and *Ranunculus aquatilis*. Several layers of filaments of *Oedogonium* were found to intertwine with the macrophytes and these in turn harboured a large number of diatoms in the mucilaginous sheath. The commonest species were *Achnanthes lanceolata, A. brevipes, A. depressa, Fragilaria, Synedra and Cocconeis*. The community was absent during January and February of 1985 and 1986 due to ice cover on macrophytes. In Allander Water an increasing diversity was observed from spring to summer which fell steadily thereafter (Fig 3c). In Glazert Water (GW2) the diversity was low and the summer increase was also rather restricted. The species richness here was the lowest of all the four sampling stations. A higher species richness was recorded in Allander Water with the usual summer maxima.

Epiphytic algal chlorophyll also showed winter minima and summer maxima (Fig 4), while the phaeophytin content (30 - 40%) was greater than for the other two communities.

Statistical analyses The quantitative data of species richness and species diversity of phytoplankton, epilithic and epiphytic algae and chlorophyll were tested for all the stations using product-moment correlation coefficients. Three sets of significant values were obtained: there was very significant correlation between temperature and algal communities ($P< 0.001$), a moderately significant correlation between chlorophyll *a* content of algal communities and orthophosphate concentration ($P<0.01$), and a somewhat significant correlation between environmental variables such as pH, DO, BOD, nitrate-nitrogen and silicate with algal communities ($P<0.05$).

Multiple regression analysis between chlorophyll *a* and eight environmental variables showed ammonia to be highly significant ($P<0.01$) to all algal communities. The chlorophyll *a* of all algal communities was moderately correlated with orthophosphate ($P<0.05$) as was seen from the product-moment coefficients.

DISCUSSION

The existence of a true plankton in streams and rivers has always been doubted with the suggestion being made that suspended algae are derived from the benthos, an inoculum from lakes or ponds in the catchment or from submerged vegetation near the banks of moderately fast flowing rivers (Hynes 1970; Whitton, 1975). In the present study, Jaccard's coefficient of similarity, based on the number of species present, showed very high similarity between planktonic and epilithic algae (0.805), planktonic and epiphytic algae (0.765) and epilithic and epiphytic algae (0.788). This indicates that the phytoplankton community was not taxonomically different from the benthic communities and so not likely to be a self sustaining one, but rather is formed from individuals dislodged from epilithic and epiphytic algae.

It is well established that environmental perturbation such as pollution changes the structure and function of biological systems. The perceptible changes in stream communities are indicated by changes in species composition, diversity, dominance and biomass. Organic pollution affects organisms by lowering the available oxygen, and by an increase in BOD and suspended solids, with a concomitant increased supply of mineral nutrients. There is a large increase in bacteria and sewage fungus (Mason, 1981). The Protozoa are chiefly predators on bacteria and increase in response to bacterial increase (Mason, 1981; Turner & Barr, 1989). Slight organic enrichment of polluted streams usually results in an increase in both the number of individuals and the diversity of the species. However, further increase in organic enrichment usually produces other environmental changes unfavourable to many of the species present, reducing the total number of species and diversity. The present study shows a similar response to a stepwise increased supply of essential nutrients from the sewage discharge in Allander and Glazert Waters. The moderate diversity at unpolluted Allander upstream (AW1) increased at nutrient rich AW2 and GW1 and was drastically reduced at GW2 where BOD was observed to be greater than DO. The low species diversity recorded in the polluted site of GW2 is similar to the suggestions of restricted diversity imposed by the selective environment (Reynolds *et al.*, 1993). The input of sewage was reflected in a change in dominance within the community at GW2 where *Nitzschia acicularis* was replaced by *N. linearis and Ceratoneis arcus* and the abundance of *Oedogonium* was reduced. However species richness was higher at both Allander Water sites than at either Glazert Water site.

The severity of the effects of pollution in part depends on the season at which it occurs. At high temperatures, metabolism of invertebrates and fish is increased so they are more susceptible to the harmful effects of pollutants. The dissolved oxygen content of the river water is also lower at high summer temperatures. The reduction in grazing pressure from herbivores in summer, when they are replaced by detritus feeders, enables Allander and Glazert Water algal communities to increase their numbers and biomass (Turner & Barr, 1989).

This change in trophic structure of the community from herbivore based to detritus based in the organically enriched streams leads to further change in different species indicating differing conditions. I found some algae, such as *Nitzschia linearis*, *Ceratoneis arcus*, *Euglena*, *Trachelomonas* and *Cryptomonas* to be widely distributed at the polluted site (GW2) and at the other three sampling stations. Other algal species, such as *Tabellaria fenestrata var. asterionelloides*, *Synedra ulna*, *Gomphonema acuminatus*, *Dinobryon divergens*, *Coelosphaerium kuetzingianum* and *Oscillatoria rubescens* were found repeatedly only at AW1, AW2 AND GW1. *Oedogonium*, *Pinnularia*, *Mastogloia*, *Meridion circulare*, *Melosira varians*, *Achnanthes lanceolata and Cyclotella comta* were also distributed more or less throughout the annual cycle except for a brief absence in the winter months. Conversely the following algae are seasonal in their distribution and dominate for a short period in spring or autumn: *Oscillatoria* sp., *Stephanodiscus astraea*, *Ceratoneis arcus*, *Tabellaria fenestrata*, *T. flocculosa*, *Cymbella ventricosa and Amphora ovalis*. *Peridinium*, *Gymnodinium*, *Dinobryon divergens*, *Ochromonas*, *Synura*, *Phacus* and *Fragilaria* appeared during late autumn. The higher silica content in winter and its lower level in spring observed in the present study followed the similar pattern established by Moss (1981). Silicate depletion in water is primarily the result of diatom productivity in spring. Blue green algae were widely distributed in the streams during summer and autumn with a peak of *Oscillatoria* in late spring to early summer and *Anabaena* and *Coelosphaerium kuetzingianum* during late summer to autumn.

Marker *et al.* (1986) showed an inversely proportional seasonal variation in chlorophyll and phaeophytin concentration in nutrient-rich chalk streams of southern Britain for epilithic and epiphytic algae. Chlorophyll was high in April and low in winter, whereas phaeophytin was high in winter and low in midsummer. However in our studies the concentration of phaeophytin closely followed the increase or decrease of chlorophyll for all three communites throughout the 21 months.

The results of product-moment analysis illustrate the variety of relationships between environmental variables and chlorophyll concentration in Allander and Glazert Waters. Multiple regression analysis revealed the levels of significant dependence of chlorophyll *a* concentration on environmental variables and they suggested that ammonia ($P<0.01$) and orthophosphate ($P<0.05$) have the greatest influence on the algal communities. The relationship between chlorophyll *a* content and orthophosphate is significant for all three algal communities in bivariate as well as multiple regression analyses.

The results highlight the important contribution of *Oedogonium*, a typical epilithic and epiphytic alga in Allander Water and Glazert Water, to the biomass estimated as chlorophyll. It is evident that the summer peak of *Oedogonium* closely follows the nitrate nitrogen decline (Bailey-Watts, 1987).

ACKNOWLEDGEMENTS

Thanks are due to Head of the Division of Environmental and Evolutionary Biology, University of Glasgow for help and encouragement, also to Mrs. Liz Denton for preparing figures. This work was supported by a Post-doctoral grant from the CAPES/MEC Brazil (Proc.No. 1352/83-2) awarded to Naithirithi Chellappa to work with Roger Tippett.

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NOTES ON COPEPOD PARASITES OF POLYCHAETE WORMS IN SCOTTISH WATERS

Including the first UK records of the Californian copepod *Spiophanicola spinosus* Ho, 1984 (Poecilostomatoida: Spiophanicolidae).

MYLES O'REILLY

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Until recently records of copepod parasites of polychaete worms in British waters have been relatively scarce (O'Reilly, 1991). The publication of a synopsis of commensal and parasitic copepods associated with British marine invertebrates (Gotto, 1993) has added impetus to their study in UK waters. A number of new finds have since come to light in the course of benthic macrofaunal monitoring surveys (O'Reilly, 1995a, b, c, Ooishi, 1996).

In June 1987 as part of routine biological monitoring of Lothian Region sewage disposal grounds, approximately 17 km north of St Abbs Head in the Forth Sea Area, grab samples of benthic invertebrates were collected. Among the thousands of polychaetes examined a small number were observed with copepod parasites. These included the Bamboo Worm, *Rhodine gracilior* Tauber, 1879, of which 11 specimens were accompanied by two different species of clausiid copepod. One of these, *Rhodinicola elongata* Levinsen, 1878, had only rarely been recorded in British waters, whilst the other much larger species, *Megaclausia mirabilis* O'Reilly, 1995, was subsequently described as a new genus in a review of the family Clausiidae (O'Reilly, 1995a).

Also discovered in the same survey were several mature and ovigerous females of the highly degenerate copepod *Herpyllobius polynoes* (Kroyer, 1863) which parasitises scaleworms. (Figs. 1, 2 - see back cover). This bizarre copepod is composed of two body portions; an oval ectosoma, 1-2 mm in diameter, which protrudes from the host's head like a large lollipop, and a tongue-shaped endosoma, several millimetres long, which penetrates deep into the scaleworm's body alongside the alimentary tract, acting as an absorptive organ. There are no appendages whatsoever save for a pair of chitinous protuberances to which large ovisacs are attached in reproductive females. Altogether four specimens of *Gattyana cirrosa* (Pallas, 1766) were parasitised, two with a single parasite and two with a pair of parasites. These represent the first Scottish east coast records (cited as south-east Scotland in Gotto, 1993).

In addition to the above, a juvenile specimen of the tube-dwelling polychaete *Spiophanes kroyeri* Grube, 1860, was recovered at the St. Abbs grounds (Stn. 11, 56°04.50'N, 02°09.04'W, 65 m depth) with a minute copepod attached dorsally (Fig. 3 - see back cover). The copepod, only 0.2 mm long, was evidently a very immature (copepodite) stage. Few morphological features were discernible, other than enlarged maxillipeds used to grasp its host. As it was not readily referable to any British species, it was put to one side in the hope that further finds of mature specimens might shed light on its identity.

Almost 5 years later, in April 1992, following a survey around a sewage discharge of Ironotter Point, Greenock, a second specimen of this unusual copepod was recovered (CRPB Stn. E1, 55°58.33'N, 04°48.20'W, 20 m depth, see O'Reilly *et al.*, 1997). This specimen, an adult female 2.5 mm long, retaining a single damaged ovisac (Fig. 4 - see back cover), and also attached to the dorsum of *Spiophanes kroyeri*, was identified as *Spiophanicola spinosus* Ho 1984, the sole member of the family Spiophanicolidae described 8 years earlier from the Californian coast.

Spiophanicola spinosus has an elongate body divisible into head, trunk, and tail. The head has well developed first and second antennae plus prominent prehensile maxillipeds. The oral appendages are minute as are the 5 pairs of legs on the elongated trunk region. The tail comprises the genital segment and a truncated abdomen terminated by a pair of short caudal rami. The paired ovisacs are attached laterally to the genital

Figure Legends - see back cover

Fig. 1 *Herpyllobius polynoes* - female with single ovisac, attached to Gattyana cirrosa. The head of the scaleworm is obscured by the parasite. Only a single anterior scale remains on the worm - visible to the left of the copepod parasite.

Fig. 2 *Herpyllobius polynoes* - close up of female attached to Gattyana cirrosa. The single ovisac is attached to one of the chitinous protuberances.

Fig. 3 *Spiophanicola spinosus* copepodite attached to dorsum of juvenile *Spiophanes kroyeri* from St. Abbs disposal grounds.

Fig. 4 Dorsal view of female *Spiophanicola spinosus* with single egg string, attached to fragment of *Spiophanes kroyeri* from Greenock, Firth of Clyde.

Fig. 5 *Spiophanicola spinosus* - mature female, lateral view, from off the Northumberland coast.

Fig. 6 *Spiophanicola spinosus* - mature female, ventral view, from off the Northumberland coast.

segment. They are usually at least as long as the body and composed of a single string of eggs, a relatively unusual feature among invertebrate associated copepods.

The discovery of *S. spinosus* in Scottish waters, briefly cited by O'Reilly (1995c), appears to represent the first find of this species since its type description from California. Coincidentally Ho (*loc. cit*) also found his material as a result of a sewage discharge monitoring survey and similarly in association with the polychaete *S. kroyeri* and 2 other allied *Spiophanes* species.

Three further records of *S. spinosus* have since come to light from North Sea surveys: 1 mature female, 2.5 mm long (Figs. 5, 6 - see back cover), detached from any host collected in Jan. 94 about 10 miles off Cullercoats, Northumberland (Dove Marine Lab., Stn. 30, 80 m depth, see O'Reilly & Geddes (in press)), 1 mature female, 1.5 mm long, attached to *S. kroyeri* collected Aug. 95 in the northern North Sea (58°22'29"N, 00°50'32"E, Donan Field, 100-130 m. depth) and 1 badly damaged female, approximately 2.0 mm long, detached from host collected May 97 in the central North Sea (56°59.02'N, 02°15.20'E, Phillips Jade Field).

The occurrence of *S. spinosus* in British waters represents a considerable extension of its known range. However, it seems reasonable to assume that a creature with such clandestine habits has always been present and that its distribution probably matches that of its hosts. In British waters it appears to be restricted to *Spiophanes kroyeri* so far. The samples where detached parasites were recovered both had *Spiophanes kroyeri* present. However it is possible that *Spiophanes bombyx* (Claparede, 1870) might also serve as a host as both species often occur together. The paucity of records for *S. spinosus* may in part be explained by its apparent low infestation rates. In the St. Abbs survey 66 *S. kroyeri* and 300 *S. bombyx* were examined; at Ironotter Point over 660 *S. kroyeri* and 40 *S. bombyx* - all to reveal only 2 parasites. However it must be borne in mind that some parasites will inevitably become dislodged from their hosts during the process of sample sieving and fixing with formaldehyde preservative.

Little is known of the biology of *S. spinosus*. Ho (*loc. cit.*) found 8 ovigerous females all attached ventrally to their hosts. The 3 attached British specimens were located dorsally on their hosts, on setigers 15, 19+?, and 25 respectively. They were oriented with their heads positioned either anteriorly or posteriorly. It is probable that *S. spinosus* can move around on the surface of its host, perhaps scraping off mucus, although its actural feeding mode is not known. The male of *S. spinosus* has never yet been observed.

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I am greatly indebted to my colleagues Peter Garwood (Dove Marine Laboratory, Cullercoats) and Sue Hamilton (Environment & Resource Technology Ltd, Edinburgh) for bringing the additional North Sea material of *S. spinosus* to my attention. The Donan specimen was collected during post-abandonment surveys. I thank Chris Herlugson of BP Exploration for their cooperation. Thanks also to Martin McGinty of Fugro Ltd and to Phillips Petroleum for permission to cite the record from the Jade Field. The Scottish material is deposited in the National Museum of Scotland, Edinburgh (Accession Nos. NMS 1999.10-13) and the Northumberland specimen is placed in the British Museum (Natural History), London (Registration No. 1999.165).

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THE DISTRIBUTION AND BIOLOGY OF *ARADUS BETULAE* (L.) (HEMIPTERA, HETEROPTERA)

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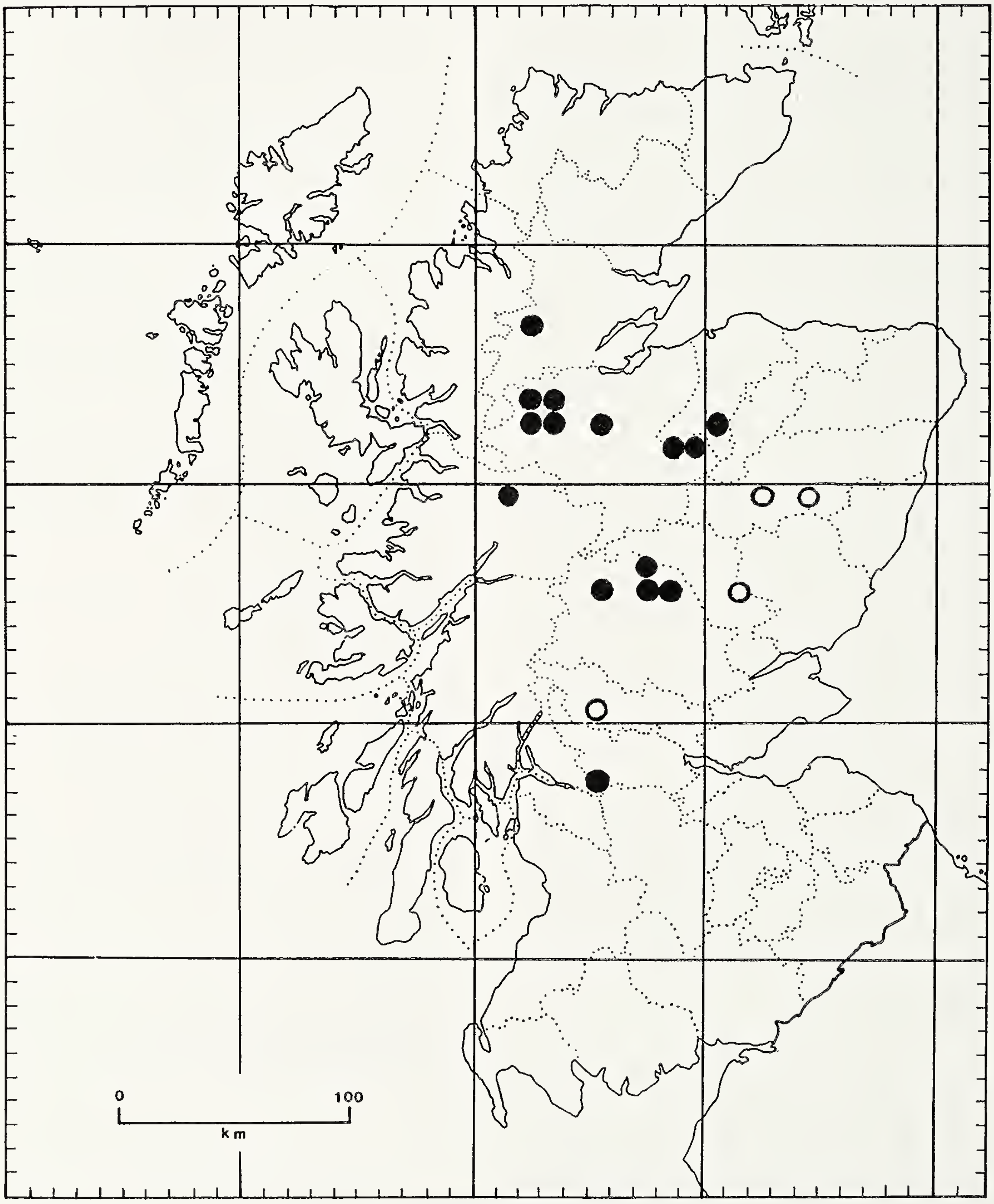

FIGURE LEGEND

Figure 1. Distribution of *Aradus betulae* in Scotland. Solid circles represent 10 km squares in which the species has been found. Open circles represent 10 km squares in which ideal habitats have been searched but the species not found.

Aradus betulae (Linnaeus, 1758) was first added to the British list in 1921 when P. Harwood discovered it near Camghouran in Rannoch, Perthshire (Harwood, 1921). Between 1921 and 1929 Harwood took some 43 specimens in this locality, all of which are currently in the Natural History Museum (NHM) collections, London (J. Martin, *pers. comm.*). Since that period the species has been recorded from several widely scattered Scottish localities (Figure 1 and see below for details). As befits its strongly dorso-ventrally flattened shape it is usually found beneath the loose bark of dead or dying birches closely associated with the fruiting bodies of bracket fungus. The preferred bracket fungus seems to be *Fomes fomentarius* (Fries) Kickx on which it feeds at night by probing into the pores of living fungus. Shirt (1987) assigns the species a RDB3 classification but more recently Kirby (1992) relegated it to Notable B status. The former status is probably more appropriate as in many localities dead and dying birch trees have become part of the temporary transition from open birch woodland to "improved" grassland. Nearly all the localities listed below are areas of long-established birch woodland. The current known distribution of the species, based on all sources, including the collections of the National Museum of Scotland (NMS), Edinburgh and Hunterian Museum (HM), Glasgow, is:

VC86 NS57 Mugdock Wood, Milngavie, viii. 1974 (Crowson, 1974); Mugdock Wood, x. 1978 (R. Crowson [HM Coll.]).

VC88 NN55 Camghouran, Rannoch, vii 1921 (Harwood, 1921); Rannoch, 1921 to 1929 (P. Harwood [NHM Coll.]); Blackwood of Rannoch, vi. 1964 (Crowson, 1974); Blackwood of Rannoch, viii. 78 (R. Crowson [HM Coll.]); Camghouran, Rannoch, vii. 1980 (R. Lyszkowski [NMS Coll.]): NN75 Tomanbuidhe, Tummel, iii. 1998: NN76 Tighmore, Rannoch, iv. 1996, Struan Wood and Kinaldy, iv. 1997: NN85 Netherton, Tummel, iii. 1998 (K.P. Bland & A.E. Whittington [NMS Coll.]).

VC95 NH81 Craigellachie, iv. 1997 (D. Horsfield, *pers. comm.*): NH91 Boat of Garten, viii. 1987 ([Porter], 1989): NJ02 Grantown-on-Spey, v. 1996 by S. Hewitt & G. Hancock (S. Hewitt, *pers. comm.* & G. Hancock, 1998).

VC96 NH22 Guishachan, 1962 by P. Skidmore (Massee, 1962); Glen Affric, vi. 1970 & viii. 1971 ([MacNulty], 1971) and vii. 1992 by P. Kirby & S. Lambert (S. Moran, *pers.comm.*): NH23 Glen Cannich, v. 1996 by S. Hewitt (Hancock 1998): NH32 Knockinfin Farm, 1962 by P. Skidmore (Massee, 1962): NH33 Strathfarrar, vii. 1992 by P. Kirby and others ([Kirby], 1994) and v. 1993 (S. Moran, *pers. comm.*): NH52 Inverfarigaig, Loch Ness, vi. 1982 (I.M. White [NMS Coll.]).

VC97 NN19 Allt Uchdain Mhoir, Loch Arkaig, vi. 1982 (I.M. White [NMS Coll.]).

VC106 NH25 Glenmeanie, Strathconon, vi. 1998 (K.P Bland & A.E. Whittington [NMS Coll.]).

The literature gives no clear indication of the life history of this species; however our experience of captive rearing of early instar nymphs indicates that nymphs take 12 months or more to become adult, thus in the field nymphs may be met with in any month of the year. Interestingly, at Glenmeanie in Strathconon some 18 individuals were found on a single tree; these consisted of 3 adults and 15 nymphs. Twelve of the nymphs were behind a single small piece of bark. These nymphs varied in size from 2.5 to 5 mm long, suggesting that two, probably three, instars were present simultaneously with the adults.

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THE BARKLICE (INSECTA: PSOCOPTERA) OF THE LOTHIANS (SCOTLAND)

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Between 1994 and 1999 a study of the Psocoptera occurring out-of-doors (often called 'barklice') was carried out in the Lothians (SE Scotland). Specimens were collected with the aim of finding out which species of barklice occur, what is their total distribution and for what periods they occur as adults. R.M. Gambles (1935) is the only other person to carry out a systematic study of Lothian Psocoptera. He recorded 19 barklice species between 1931 and 1934. This list has been considerably extended and some changes in the fauna seem to have occurred in the intervening 60 years. In addition to the 19 outdoor species, Gambles (1935) recorded five Psocoptera species in the Lothians which were only found indoors. These species *(Nymphopsocus destructor, Trogium pulsatorium, Lepinotus inquilinus, L. patruelis and Liposcelis divinatorius)* are not included in the following systematic accounts.

Barklice are very numerous and can be found in a range of situations. Most effort was spent in finding the species that occur amongst the foliage of trees, such species being collected by shaking branches over a beating tray. From mid-August 1998 sampling of the barklice on tree trunks was done by brushing the trunk down with a soft paint-brush and catching any dislodged specimens on a beating tray held against the trunk. Other techniques used, though less frequently, were sieving of leaf litter and bird nest material and searching under stones. All specimens collected were stored in 70% industrial methylated spirit. A wide range of tree and shrub species were searched including oak, ash, elm, lime, beech, birch, goat willow, elder, hawthorn, pine, larch, yew, holly, sea buckthorn, broom, gorse and heather. Some trees held a greater variety of barklice species than others and the most productive were yew (16 species on foliage), oak (15 on foliage and trunks) and pine (13 on foliage and trunks).

Altogether specimens were collected from 133 localities in the Lothians. Most of the localities that were mentioned by Gambles (1935) have been included in the species accounts. During the present study some of the species were found on only a small number of occasions. All of the localities where these species were recorded have been included in the accounts, the specific collecting area being given by a 6-figure OS grid reference. The numbers of the Watsonian vice-counties where each species has been recorded has also been noted (vc 82 = East Lothian, 83 = Midlothian and 84 = West Lothian). The specimens collected between 1994 and 1998 were not retained (apart from a small reference collection). The building up of a representative series of specimens was begun in 1999 and will continue during future studies. This collection will be deposited in the National Museum of Scotland, Edinburgh.

Between 1994 and 1998 specimens were identified using the key in New (1974), from 1999 the keys in Lienhard (1998) were used. Four species have been found during this study that are not mentioned in New (1974): *Caecilius pilipennis, Ectopsocus axillaris, E. petersi and Philotarsus parviceps*. All of these species are included in Lienhard (1998). In general, the identification of barklice is not too difficult and no preparation of microscope mounts is required, except to separate males of *Peripsocus phaeopterus* and *P. didymus*. A total of 35 species were recorded which included all of the barklice found by Gambles and also four species new to Scotland (*Peripsocus alboguttatus, P. subfasciatus, Philotarsus parviceps and Trichadenotecnum majus*), one new to the United Kingdom (*Ectopsocus axillaris*) and one new to the British Isles (*Caecilius pilipennis*). The following summarises the findings. Full details of all the records (circa 1,000) are held on the Lothian Wildlife Information Centre's database. The nomenclature is that used by Lienhard (1998). The names used by Gambles (1935), where different from the currently used ones, have been included in brackets.

Family **Lepidopsocidae**

Pteroxanium kelloggi (Ribaga, 1905) vc 83

A distinctive species with pointed, scale-like wings only about half the length of the abdomen. Found in small numbers in a range of situations: conifer foliage, deciduous tree trunks and under stones. So far it has not been recorded in its 'normal' habitat of leaf-litter (New, 1974). Has been found at six localities and adults have been seen in the autumn and winter (13 Aug.-16 Dec.). Not seen by Gambles (1935).

Family **Trogiidae**

Cerobasis guestfalica Kolbe, 1880 vc 82, 83
(= *Hyperetes guestfalicus*)

One of the few almost apterous barklice, this species has a characteristic anchor-shaped mark on the forehead. Gambles (1935) found it to be common on tree trunks especially beech and pine, on walls, palings and sometimes in old barns. In the Lothians he noted it in the Glencorse neighbourhood (May 1932) and at Ratho (Jul. 1933). It has been found during the recent study at 19 localities on the foliage and trunks of both deciduous trees and conifers and also on gorse; at one site it was found under stones. Adults have been found during the current study between 1 July and 26 February.

Family **Epipsocidae**

Epipsocus lucifugus (Rambur, 1842) vc 82, 83, 84

The most frequent psocid found under stones though also known from leaf litter. It has been found at eight localities three of which were gardens (17 Aug.-4 Oct.). Not seen by Gambles (1935).

Family **Caeciliusidae**

Caecilius burmeisteri Brauer, 1876 vc 82, 83, 84

Recorded by Gambles (1935) at Glencorse Kirkyard (Sep. 1932) and Dalmeny (Oct. 1932 and Jun. 1934). It has now been found at 32 localities, most frequently on the foliage of conifers, especially yew (20 Jun.-1 Feb.). The typical form of *C. burmeisteri* has uniformly grey wings, but specimens of a *Caecilius* species were found (usually on yew) that had more brownish wings with hyaline patches in the same positions as the rare *C. atricornis*. This is, in fact, a dark form of C. *burmeisteri* (Lienhard, pers. com.).

Caecilius flavidus (Stephens, 1836) vc 82, 83, 84

This is one of the commonest species (found at 53 localities) and it usually occurs on the foliage of deciduous trees. More rarely it has been found on the trunks of deciduous trees, on yew and holly, in leaf litter and, on one occasion, under a stone. It has been recorded between 17 June and 22 December. Gambles (1935) also found it to be common and similarly occurring mainly in the foliage of deciduous trees and bushes though he also noted it occasionally on nearby walls.

Caecilius fuscopterus (Latreille, 1799) vc 83

Found on deciduous trees at two ancient woodland sites. Two specimens were taken at Balerno Wood (at NT165663 on 11 Aug. 1996) and one at Roslin Glen (at NT277627 on 6 Aug. 1998). Not seen by Gambles (1935).

Caecilius pilipennis Lienhard, 1996 vc 82, 83, 84

An introduced species that is new to Britain. The only record in the world made prior to the Lothian sightings was of three specimens found at one site on Madeira (Lienhard, 1996). On Madeira it was found on *Erica* and dead vegetation near soil but in this country it occurs almost invariably on the trunks of mature deciduous trees. The only exceptions were of one specimen found on the foliage of an oak tree and two others on yew. It has been found at 14 localities most being within a few kilometres of the coast though one site, Colstoun Wood, is 11 kilometres inland. *C. pilipennis* is an unusual species in that the females are usually fully winged whereas the males are brachypterous, which is the opposite way round from the normal situation with other sexually dimorphic psocids. The species was recorded between 15 August and 26 February. No searching has been carried out for this species outside of this date range and it is likely that adults can be found both before and after this period.

Enderleinella obsoleta (Stephens, 1836) vc 83
(= *Caecilius obsoletus*)

Gambles (1935) reported that this species was not uncommon and could be found on conifers, especially spruce and juniper. The only site he mentioned was Flotterstone where he found the species in abundance in September 1932. I have only found the species at Cramond (NT191767) on yew (one specimen found on 17 Jul. 1998 and two on 7 Sep. 1998).

Family **Stenopsocidae**

Stenopsocus immaulatus (Stephens, 1836) vc 82, 83, 84

This moderately large and conspicuous species has been found at 32 localities making it one of the most frequently recorded Lothian barklice. It is consequently somewhat surprising that Gambles (1935) did not record it at all. It is found mainly on the foliage of deciduous trees, more rarely on conifers and tree trunks, and on one occasion in leaf litter (28 Jun.-30 Nov.).

Graphopsocus cruciatus (Linnaeus, 1768) vc 82, 83, 84
(= *Stenopsocus cruciatus*)

Huie (1916) noted that this easily recognisable species (see Fig. 1 - Plate 2, centre pages, bottom) was common in Edinburgh in 1911 but that she had not seen it since. Gambles (1935) found it to be not uncommon and occurred in the foliage of deciduous trees and bushes and on one occasion on yew (Jul.-Sep. 1931-4). It is still one of the commonest species and has been recorded at 46 localities, mainly in the foliage of deciduous trees but also on conifers (particularly yew) and on tree trunks (5 Jun.-5 Jan.).

Family **Lachesillidae**

Lachesilla pedicularia (Linnaeus, 1758) vc 82, 83, 84
(= *Pterodela pedicularia*)

Gambles (1935) found this species, "In haystacks etc. Frequently observed on the wing, alighting in houses, on bark, or in foliage." He recorded the species between July and October at Edinburgh, near Swanston, South Queensferry and Flotterstone. The only sightings in the present study were of three specimens found on foliage of deciduous trees at Birny Knowe (NT707699) and Sheeppath Glen (NT704705) on 17 Aug. 1996.

Family **Ectopsocidae**

Ectopsocus axillaris (Smithers, 1969) vc 83

Twelve specimens of this small, dark species were found in the foliage of yew trees at Lauriston Castle, Edinburgh (NT203759) between 26 Jan. 1999 and 19 Feb. 1999. These specimens consisted of two macropterous females, four brachypterous males and six brachypterous females. These sightings are the first for the United Kingdom, the species having been recorded previously from New Zealand, Australia and Ireland. It is still uncertain which is the country of origin.

Ectopsocus briggsi McLachlan, 1899 vc 82, 83, 84

This small species was found on just two occasions by Gambles (1935), once on a haystack at Hermiston (Jul. 1933) and once on a stone wall at Blackford Hill (Oct. 1933). These sightings represent the earliest Scottish records. During the intervening 60 years there has been a dramatic increase in the numbers of this species and today it is one of the most widespread barklice. It has been found, usually in good numbers, at 47 localities. It occurs equally frequently in the foliage of deciduous trees and evergreens and has been noted on hawthorn, ash, oak, lime, sea buckthorn, holly, pine, yew and gorse. Unlike the following species it has been found only rarely on tree trunks. It also occurred in leaf litter and one specimen was found in a bird nest. Adults have been recorded all year round.

Ectopsocus petersi Smithers, 1978 vc 82, 83, 84

New (1974) mentioned that there was an undescribed brachypterous species of the *briggsi* group present in Britain. *E. petersi*, a species new to science, was described by Smithers (1978) from Irish material, the females of which are usually brachypterous. This species has been extremely successful at colonising the Lothians and is today by far the commonest barklouse, and has been recorded, in numbers, at 80 localities. It occurs in the foliage of deciduous trees and evergreens and on tree trunks. Occasional specimens have also been found in bird nests, leaf litter, compost heaps, tall herbs and on straw bales. As with *E. briggsi*, adults have been recorded all year round.

Family **Peripsocidae**

Peripsocus alboguttatus (Dalman, 1823) vc 82

Two specimens were found on deciduous tree foliage at Birny Knowe (at NT707699 on 17 Aug. 1996). This is the first Scottish record.

Peripsocus didymus Roesler, 1939 vc 83

This species is superficially similar to the commoner *P. phaeopterus* and males can only be separated by dissection. It has been found on coniferous and deciduous tree foliage near Carrington Mill (at NT320597 on 6 Aug. 1998) and the Water of Leith (at NT244742 on 15 Aug. 1998). Not seen by Gambles (1935).

Peripsocus phaeopterus (Stephens, 1836) vc 82, 83, 84

Care is needed to distinguish this species from *P. didymus*. It is found among foliage of deciduous and coniferous trees and bushes. Gambles (1935) also obtained one specimen from a stone wall. He noted the species from one site, Blackford Hill (Oct. 1931). It has now been found at 16 localities (24 Jul.-22 Sep.).

Peripsocus subfasciatus (Rambur, 1842) vc 82, 83, 84

Although this is the commonest *Peripsocus* species with patterned wings, it is not often seen. It has been found on foliage and trunks of a range of mainly deciduous trees at seven localities (15 Jul.-30 Sep.). These are the first records of the species in Scotland. The wing patterning often does not closely match that shown in New (1974) but is closely similar to the illustration in Badonnel (1943).

Family **Trichopsocidae**

Trichopsocus dalii (McLachlan, 1867) vc 82, 83

A very pale species with distinctive green eyes. Gambles (1935) stated that it is found quite commonly in the open in the extreme south of England, but further north is usually confined to greenhouses etc. He also stated that he had recorded the species from the Royal Botanic Garden Edinburgh (Apr. 1932). It is possible, however, that the species referred to by Gambles was actually *T. clarus* (Lienhard, pers. com.). *T. dalii* has been recorded during the current study at seven localities. It occurs mainly on yew but has also been found on holly, sea buckthorn and oak. All of its sites are within a kilometre of the coast. It has been recorded as an adult throughout most of the year (Jan., Feb., May, Jul., Aug., Sep., Nov. and Dec.).

Family **Elipsocidae**

Reuterella helvimacula (Enderlein, 1901) vc 83

This species has been taken, mainly on tree trunks, at six localites. The trees where it occurred were mainly deciduous though at one site it was taken on a mature conifer. Gambles (1935) also found it occasionally on palings. He recorded the species in the Glencorse neighbourhood (Sep. 1932) and at Ratho (Jul. 1933). Adults have been found between July and October. The species shows sexual dimorphism, the males being winged, the females apterous.

Cuneopalpus cyanops (Rostock, 1876) vc 82, 83, 84
(= *Elipsocus cyanops*)

This species differs from other psocids in having a pale blue ring around each eye. It is one of the few species that appears to be almost restricted to one tree species, occurring on the foliage of pines. Gambles (1935) recorded it at Blackford Hill and near Glencorse Reservoir. The species still occurs at Glencorse and I have seen it at an additional eight sites (25 Jun.-9 Sep.).

Elipsocus hyalinus (Stephens, 1836) vc 82, 83, 84
(= *E. abietis* sensu Gambles, 1935)

Gambles (1935) recorded both *E. hyalinus* and *E. abietis* Kolbe 1880 in the Lothians. At that time the name *hyalinus* was used for what is today *abdominalis*, *abietis* is the actual *hyalinus*. He remarked that E. *hyalinus* (recorded as *abietis*) was apparently restricted to conifers and had found it on dead gorse at the foot of a pine tree at Glencorse Reservoir (May 1932). *E. hyalinus* has now been found to be the most widespread *Elipsocus* species and was recorded at 30 localities. It occurs mainly on the foliage of deciduous trees but has also been recorded twice on pine and once each on larch, sea buckthorn and nettles. Adults have been recorded in what appear to be two distinct periods: 18 Apr.-15 Jun. and 23 Jul.-3 Nov.

Elipsocus abdominalis Reuter, 1904 vc 82, 83
(= *E. hyalinus* sensu Gambles, 1935)

This species was referred to as *E. mclachlani* in New (1974) , but this name was placed in synonymy by Lienhard (1985).

Gambles (1935) found the species (recorded as *E. hyalinus*) infrequently on tree trunks and walls, and had never taken it from foliage anywhere in Scotland. In the Lothians he recorded it at Cramond (Jul. 1934). Two specimens of *E. abdominalis* have been taken during the current study and both were noticeably smaller than the similar but much commoner *E. pumilis*. One was found at Birny Knowe (at NT707699 on 17 Aug. 1996) and the other at Lothianbridge (at NT325649 on 4 Sep. 1998). Both were taken from deciduous trees.

Elipsocus pumilis (Hagen, 1861) vc 82, 83, 84
(= *E. westwoodi* McLachlan, 1867)

Gambles (1935) noted that this was a very common species, found everywhere. He recorded it in the foliage of deciduous trees and sometimes pine; on tree trunks, walls, palings etc. He found it to be abundant annually throughout Edinburgh from June to October. I have also found it most frequently in the foliage of deciduous trees, less commonly on tree trunks. The species was also found in the foliage of conifers at four of the 27 localities from which it has been recorded. Adults found 5 Jun.-12 Oct. though a dead specimen was found on 6 Jan. 1999.

Family **Mesopsocidae**

Mesopsocus immunis (Stephens, 1836) vc 82, 83, 84

This widespread species, which has been found at 35 localities, was not recorded by Gambles (1935) from anywhere in Scotland (though he may not have made the distinction between this and the following species). *M. immunis* has been taken mainly from the foliage of deciduous trees, less frequently on conifers (mainly pine). Adults have been recorded between 5 Jun. and 4 Sep. though only a few individuals (all female) were found in August and September.

Mesopsocus unipunctatus (Müller, 1764) vc 82, 83, 84

Gambles (1935) considered that this was the commonest species in Scotland, abundant everywhere on walls, palings, trunks of trees, both deciduous and coniferous, and in the foliage. He recorded the species at nine localites and found it annually at Blackford Hill from June to October. He noted that males are mostly dead by the end of July. It is now found less commonly than *M. immunis* and has been taken at 19 localites, from the foliage of deciduous trees though at three localities it occurred on conifers and at one on heather. Adults occur in the summer and were recorded over a restricted period (5 Jun.-24 Jul.).

Family **Philotarsidae**

***Philotarsus* sp.** vc 82, 83, 84

Lienhard (1998) mentions that two species of *Philotarsus* occur in Britain: *P. picicornis* (Fabricius, 1793) and *P. parviceps* Roesler, 1954. Only one of these *(picicornis)* is described in New (1974). All of the specimens collected during the current study were recorded as *P. picicornis* and it was only in retrospect, after learning how to distinguish *P. parviceps*, that I realised that both species are in fact present. An adequate series of voucher specimens were note retained so it is not possible to indicate locations for the two species. *Philotarsus* species were recorded frequently (51 localities) and were found in the foliage of deciduous and coniferous trees, and on tree trunks (26 Jul.-9 Nov.).

Gambles (1935) recorded *P. flaviceps* (a synonym of *P. picicornis*) at Glencorse (Sep. 1932) and Ratho (Jul. 1933). In the light of the occurrence of *P. parviceps* in Britain, Gambles records may refer to one or both of the *Philotarsus* species.

Family **Psocidae**

Amphigerontia bifasciata (Latreille, 1799) vc 82, 83, 84

Gambles (1935) found this species on firs and larches at Glencorse Kirkyard and Flotterstone (Sep. 1932). It has now been found at 16 localities mainly in the foliage of deciduous trees (3 Aug.-21 Sep.). Recorded on goat willow, sea buckthorn, larch and pine.

Amphigerontia contaminata (Stephens, 1836) vc 82, 83

Gambles (1935) noted that this species was very common in and about Edinburgh on walls and tree trunks (Sep.-Oct. 1931-4). I have found it only infrequently and in curiously diverse localities: on trees at Red Moss (at NT163638 on 28 Jul. 1996), on elm in a hedge near Haddington (at NT504751 on 21 Aug. 1998) and on sea buckthron at Ferny Ness (at NT441776 on 21 Aug. 1998 and 19 Sep. 1998) and Seton Sands (at NT428761 on 19 Sep. 1998). Large numbers were found at Ferny Ness on 21 Aug. 1998.

Metylophorus nebulosus (Stephens, 1836) vc 82, 83

A large species found at 11 localities mainly in Midlothian. The majority of specimens have been shaken from the foliage of deciduous trees though two were taken from larch. Adults have been found over a fairly restricted period (3 Aug.-21 Sep.). Care needs to be taken identifying the species using New (1974) because the wing illustration, although he does not mention it, is of a male. Females wings are more strongly patterned (see Badonnel, 1943). Not seen by Gambles (1935).

Psococerastis gibbosa (Sulzer, 1776) vc 82

P. gibbosa is the largest British psocid species. A single specimen was found at Sheeppath Glen on hazel foliage (at NT707708 on 12 Oct. 1998). Not seen by Gambles (1935).

Trichadenotecnum majus (Kolbe, 1880) vc 83

Two female specimens were found at North Merchiston Cemetery, Edinburgh (NT234722) on the trunks of deciduous trees (21 Aug. 1998 and 13 Sep. 1998). This is the first occurrence of this species in Scotland.

Trichadenotecnum sexpunctatum (Linnaeus, 1758) vc 82, 83

Occurs predominantly on the trunks of deciduous trees though Gambles (1935) occasionally found it on stacked logs and stone walls and I have come across it on the trunk of a conifer. It has been recorded from 12 localities between 27 July and 23 October. Care must be taken in separating this species from *T. majus*.

Loensia fasciata (Fabricius, 1787) vc 82, 83

Only three specimens of this distinctive species have been found. One occurred on the branches of a Scots pine by Glencorse Reservoir (at NT218640 on 25 Jun. 1998), the other two were found on the trunks of an oak and a conifer at Colstoun Wood (at NT534706 on 1 Jul. 1998). Not seen by Gambles (1935).

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SCOTTISH INSECT RECORDS FOR 1997

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The aim of this compilation is to bring together records of interest that have come to the attention of active field workers in Scotland. In the following list, specific names of Lepidoptera are as in Bradley (1998), a new checklist updating the British fauna. As these entries are numbered, following the well-established system initiated by Bradley & Fletcher (1979) family names have been omitted. Similarly, a new check list of the British Diptera has been published within the last year which not only brings the situation up to date regarding the actual species we have but also conforms to the classification used throughout Europe and the rest of the world (Chandler, 1998). Other orders of insects follow the names that are given in Kloet & Hincks (1964, 1977, 1978).

ODONATA

LIBELLULIDAE

Orthetrum coerulescens (Fabr.). Turraman Loch, Colonsay (NR392955), V.C.102, 4/6/97, AAJ.

NEUROPTERA

SISYRIDAE

Sisyra fuscata (Fabr.). Speybank, Inverness, three cocoons under loose alder bark (NH8506), V.C.96, 13/4/97, EGH. Two cocoons produced adults but from the third emerged an hymenopterous parasitoid (see below).

HEMIPTERA HETEROPTERA

HYDROMETRIDAE

Hydrometra stagnorum (Linn.). Lake of Menteith, Perthshire (NN5800), V.C.87, 21/4/97, KPB.

LEPIDOPTERA

376 *Synanthedon scoliaeformis* (Borkhausen). The Trossachs, Perthshire, workings with cocoons in birch trunks (NN4906), V.C.87, 21/4/97, KPB.

381 *S. culiciformis* (Linn.). The Trossachs, Perthshire, workings with cocoons in birch stumps (NN4906), V.C.87, 21/4/97, KPB.

513 *Coleophora potentillae* Elisha. Glen Fender meadows, Perthshire, single larval case in *Geum rivale* (NN8967), V.C.89, 13/9/97, KPB. New vice county record.

880 *Mompha langiella* (Hübner). Methven Wood, Perthshire, larva mining leaves of *Epilobium obscurum* (NO0526), V.C.88, 8/6/97, KPB. Adult emerged 3/7/97 to become the third Scottish record for this species.

1545 *Colias croceus* (Geoffroy in Fourcroy) Clouded Yellow. Newmilns, Ayrshire (NS5337), V.C.75, 28/5/97, JM.

1553 *Anthocharis cardamines* (L.) Orange Tip. Lamlash, Arran (NS027312), V.C.100, 15.5 - 8.6.97, MS; Crarae (NR98575), V.C.98, 19.5.97, HDR; Leckhelm, near Ullapool (NH1690), V.C.105, 21/5/97, M&PS; An Tairbeart, Tarbert (NR856685), V.C.101, 27-28/5/97, JA; northeast of St. Blanes Hill, Bute, (NS096527), V.C.100, 28/5/97, LSG; Kilmichael Glen, near Lochgilphead (NR875974), V.C.98, 2/6/97, JH; Lamlash, Arran (NS024302), V.C.100, 2/6/97, RT; Scourie (NC1544), V.C.108, 6/6/97, EB; Culloden moor, Inverness (NH776442), V.C.96, 8/6/97, VT; Glenelg (NG825200), V.C.97, 23/6/97, GS; Campbeltown (NR7120), V.C.101, 8/97, IMS; north of Whiting Bay, Arran (NS052276), V.C.100, 1997, DMF. The earliest record for 1997 was at Lanark (NS8842), V.C.77, 7/4/97, AG; latest record Pollok Country park, Glasgow (NS5561), V.C.76, 3/8/97, FO. The orange tip is continuing to expand its range to the north and west.

1555 *Callophrys rubi* (Linn.) Green Hairstreak. Toxsidehill Moss, Midlothian (NT2954), V.C.83, 1/6/97, KPB. Two adults seen in one of only two known sites for Midlothian.

1557 *Quercusia quercus* (L.) Purple Hairstreak. Torwood Glen, nr Stenhousemuir (NS833854), V.C.86, 8/8/97, KW.

1573 *Aricia artaxerxes* (Fabr.) Northern Brown Argus. Fealar Gorge, Perthshire (NO0079), V.C.89, 22/9/97, KPB.

1590 *Vanessa atalanta* (L.) Red Admiral. Widespread during 1997 with the earliest record at Duntrune (NR795957), V.C.98, 11/4/97, TCS; latest record in Glasgow (NS6269), V.C.77, 19/10/97, BZ.

1591 *Cynthia cardui* (L.) Painted Lady. Very few records compared with 1996. Mugdock Country Park, several sightings (NS5477), V.C.86, 8/4 - 3/6/97, GC; Knockentiber (NS3939), V.C.75, 23/5/97, JPB; Dundonald (NS363348), V.C.75, 29/5/97 and 18/8/97, ERW; Gutcher's Isle, Colvend, (NX865526), V.C.73, 17/7/97, R&BM; Glen Lochy (NN298318), V.C.98, 24/8/97, TCS; Kellie Castle (NO5205), V.C.85, 8/97, MR.

1607 *Argynnis aglaja* (L.) Dark Green Fritillary. Craigallian (NS5377), V.C.86, 23/6/97, MCP.

1614 *Pararge aegeria* (L.) Speckled Wood. Kirkmadrine, single specimen, probable vagrant from Northern Ireland (NX080482), V.C.74, 4/7/97, PK.

1629 *Aphantopus hyperantus* (L.) The Ringlet. Near Tinloch, Kirkintilloch (NS685748), V.C.86., 9/7/97, EGH.

COLEOPTERA

CARABIDAE

Carabus arvensis Herbst. Nr Moffat (NY0392), V.C.72, 6-9/97; nr Crieff (NN9225), V.C.88, 6./97-9/97, SB.

Carabus nitens Linn. Crianlarich (NN3530), V.C.88, 6/97, SB.

Notiophilus germinyi Fauvel. Nr Moffat (NY0392), V.C.72, 6/97; nr Crieff (NN9225), V.C.88, 6/97-8/97; nr Crieff (NN9423), V.C.88, 7/97; Angus (NO6580), V.C.90, 8/97, SB.

N. palustris (Duftschmid). Nr Moffat (NY0392), V.C.72, 6/97; nr Crieff (NN9225), V.C.88, 7/97, SB.

Dyschirius globosus (Herbst). Yesnaby, Sandwick, Orkney, fairly plentiful under stones (HY222165), V.C.111, 5/6/97, MS. Apparently new to Orkney as not in the list in Berry 91985).

Miscodera arctica (Paykull). Nr Crieff (NN9225), V.C.88, 6/97, SB.

Trechus rubens (Fabr.). Crianlarich (NN3528), V.C.88, 6/97, SB.

Bembidion biguttatum (Fabr.). Nr Crieff (NN9225), V.C.88, 6-7/97, SB.

B. laterale (Samouelle). Mull (NM7333), V.C.103, 28/6/97, SB.

B. quadrimaculatum (Linn.). Nr Moffat (NY0385 and NY0485), V.C.72, 6-7/97, SB.

B. saxatile Gyllenhal. Mull NM7333, V.C.103, 28/6/97, SB.

Stomis pumicatus (Panzer). Near Crieff (NN9522), V.C.88, 6-8/97; Angus (NO6874), V.C.90, 8/97, SB.

Olisthopus rotundatus (Paykull). Nr Moffat (NY0385), V.C.72, 8/97; nr Crieff, (NN9225), V.C.88, 8-9/97, SB.

Amara eurynota (Panzer). Nr Crieff (NN9522 and NN9523), V.C.88, 6/97, 8-9/97; Angus (NO6678 and NO6776), V.C.90, 8-9/97, SB.

Dicheirotrichus gustavi Crotch. Mull (NM7333), V.C.103, 28/6/97, SB.

Bradycellus verbasci (Duftschmid). Nr Crieff (NN9522), V.C.88, 9/97; nr Moffat (NY0385), V.C.72, 9/97, SB.

Cymindis vaporariorum (Linn.). Nr Crieff (NN9225), V.C.88, 7/97, SB.

STAPHYLINIDAE

Philonthus fimetarius (Gravenhorst). Bay of Skaill, Sandwick, swept near seashore, (HY234198), 27/5/97; Waulkmill, Orphir, Orkney, swept on saltmarsh (HY379067), V.C.111, 4/6/97, MS. Previously recorded in Orkney by Poppius (1904-5).

Staphylinus aeneocephalus Degeer. Yesnaby, Sandwick, Orkney, several under stones (HY222165) V.C.111, 5/6/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

Mycetoporus splendidus (Gravenhorst). Yesnaby, Sandwick, Orkney, several under stones (HY222165) V.C.111, 5/6/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

Tachyporus dispar (Paykull). Yesnaby, Sandwick, Orkney, under stones (HY222165) V.C.111, 5/6/97, MS. Probably new to Orkney as this species was only formally added to the British list in 1988 (Hodge & Jones, 1995).

Atheta (Microdota) liliputana (Brisout). Waulkmill Bay, Orphir, swept from saltmarsh (HY379067), V.C.111, 4/6/97, MS. Apparently new to Orkney as not in the list in Berry (1985), determined by Dr J.A. Owen.

A. (Mocyta) amplicollis (Mulsant & Rey). Yesnaby, Sandwick, Orkney (HY222165) V.C.111, 27/5/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

A. (M.) orbata (Erichson). Bay of Skaill, Sandwick, on sandy shore under dense grass (HY234198), V.C.111, 27/5/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

A. (Acrotona) aterrima (Gravenhorst). Bay of Skaill, Sandwick, two specimens swept close to seashore (HY234198), V.C.111, 27/5/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

A. (Phyconoma) immigrans Easton. Waulkmill Bay, Orphir, two sifted from seaweed strand at high tide level (HY379067), V.C.111, 4/6/97, MS. Apparently new to Orkney as not in the list in Berry (1985), determined by Dr J.A. Owen.

PTILIIDAE

Ptenidium punctatus (Gyllenhal). Waulkmill Bay, Orphir, abundant in seaweed strand (HY379067), V.C.111, 4/6/97, MS. Apparently new to Orkney as not in the list in Berry (1985).

SCARABAEIDAE

Trichius fasciatus (L.). Craigellachie, nr Aviemore, Inverness (NH8811), V.C.96, EGH. Determined by Dr R.A. Crowson from larva found in rotten birch log.

TENEBRIONIDAE

Bolitophagus reticulatus (Linn.). Craigellachie, nr Aviemore, Inverness, in old Fomes fungus fruiting bodies on fallen birch trunks (NH8811), V.C.96, 11-13/4/97, EGH.

CERAMBYCIDAE

Tetropium gabrieli Weise. Ballinluig, Perthshire (NN9753), V.C.88, 7/6/97; Nethy Bridge, Inverness (NJ0020), V.C.95, 22/6/97, EGH.

CHRYSOMELIDAE

Donacia clavipes Fabr. Dervaig, Mull swept from Phragmites stand on salt marsh, (NM4351), V.C.103, 19/6/97, EGH (det G.N. Foster).

CURCULIONIDAE

Eremotes ater (Linn.). Abernethy Forest, Inverness, under bark of felled pines in saw mill and in stumps near Forest Lodge (NJ0116), V.C.96, 13/4/97, EGH.

DIPTERA

TIPULIDAE

Tipula (Odonatisca) nodicornis Meigen. Ballinluig, Perthshire, female ovipositing on sandy margins of river Tummel (NN9753), V.C.88, 7/6/97, EGH. Unrecorded in any watershed south of Dalwhinnie, being known previously from the Spey and Findhorn.

T. (Dendrotipula) flavolineata Meigen. Carsaig, Mull, empty pupal cases protruding from dead lime trunk (NM5421), V.C.103, 29/6/97, MRS & AEW (det EGH).

T. (Savtshenkia) grisescens Zetterstedt. Speybank, Inverness, single adult swept (NH8506), 13/4/97, EGH.

LIMONIIDAE

Gnophomyia vitripennis (Gimmerthal). Gordon Moss, Berwicks, larva under bark fallen aspen (NT6342), V.C.81, 20/3/97; Falls of Clyde, Lanarks, adults at sap run on poplar (NS8841), V.C.83, 29/3/97, DMR.

Rhipidia ctenophora Loew. Penicuik, Midlothian, larvae in decaying heartwood of live sycamore (NT2360), V.C.83, 29/3/97, DMR. First rearing record from Scotland.

Molophilus pleuralis, de Meijere. Dervaig, Mull, swept from *Phragmites* stand on salt marsh, (NM4351), V.C.103, 19/6/97, EGH.

Tasiocera laminata Freeman. Calgary, Mull, swept from ditch at landward side of machair (NM3751), V.C.103, 29/6/97, EGH.

PSYCHODIDAE

Telmatoscopus advenus (Eaton). Penicuik, Midlothian, larvae in decaying heartwood of live sycamore (NT2360), V.C.83, 29/3/97; Leith, Edinburgh, adults on exposed sapwood of sycamore, V.C.83, 29/3/97, DMR.

MYCETOBIIDAE

Mycetobia gemella Mamaev. Nr Abernethy Lodge, Inverness, adults reared from water-filled rot hole in cut pine stump, (NJ017158), V.C.96, 23/6/97, EGH. Recently recorded new to Britain (Hancock, et al. 1996).

M. obscura Mamaev. Fungarth Wood, Perthshire, reared from larvae in sap run on birch (NO0343), V.C.89, 26/2/97; Gordon Moss, Berwickshire, birch sap run (NT6342), V.C.81, 20/3/97, DMR; Craigellachie, Inverness, larvae in rot hole in birch (NH8811), V.C.96, 13/4/97, EGH. Recently recorded new to Britain (Hancock, et al. 1996).

CULICIDAE

Anopheles plumbeus Stephens. Calgary, Mull, larvae in rot hole in sycamore (NM3751), V.C.103, 29/6/97, EGH. A specific search was made for Phaonia exoleta (Meigen), a muscid fly whose larvae are predators of these tree-dwelling mosquitoes, but none could be found.

CERATOPOGONIDAE

Forcipomyia pulchrithorax Edwards. Speybank, Inverness, larva in decaying sapwood of fallen birch branch (NH8506), V.C.96, 13/4/97, DMR.

XYLOPHAGIDAE

Xylophagus ater Meigen. Balnakailly Burn, Bute, adult at rest on fallen oak branch (NS023742), V.C.101, 14/5/97, EGH.

TABANIDAE

Tabanus sudeticus Zeller. Balmaha, Loch Lomond, adult (?male) at rest on car (NS421908), V.C.86, 26/8/97, BP.

ASILIDAE

Neoitamus cyanurus (Loew). Ballinluig, Perthshire (NN9753), V.C.88, 7/6/97, EGH.

DOLICHOPODIDAE

Medetera inspissata Collin. Gordon Moss, Berwickshire, larvae under bark of fallen aspen (NT6342), V.C.81, 20/3/97, DMR.

Systenus bipartitus (Loew). Speybank, Inverness, larva in sap run on birch (NH8506), V.C.96, 13/4/97; Leith Links, Edinburgh, adults on exposed sapwood of ash (NT2775), V.C.83, 1-4/8/97, DMR.

DROSOPHILIDAE

Leucophenga maculata (Dufour). Leith Links, Edinburgh, adults on *Grifola sulphurea* bracket on ash (NT2775), V.C.83, 23/7 - 16/9/97, DMR.

AGROMYZIDAE

Ophiomyia gnaphalii Hering. Gleann Mór, Fealar, Perthshire (NO0076), V.C.89, 25.9.97, KPB. Second British record and new to Scotland.

Phytomyza diversicornis Hendel. Aberlady Bay, East Lothian, puparia in stems of *Pedicularis palustris* (NT4680), V.C.82, 4/1/97, KPB. This species was announced recently as new to Britain (Bland, 1999) and has now been recorded in vice-counties 80, 88, 89, 90 and 103.

P. isais Hering. Isle of Iona, puparia in seed heads of *Odontitis verna* (NM2824), V.C.103, 15/9/97, KPB. New to Scotland and has been found at other sites in vice-counties 82 and 84.

P. rostrata Hering. Aberlady Bay, East Lothian, puparia in stems of *Rhinanthus* sp. (NT4680), V.C.82, 4-11/1/97, KPT. This species was announced recently as new to Britain (Bland, 1999) and has been recorded also in vice-counties 88 and 89.

P. trollivora Hering. Glen Fender meadows, Perthshire, leaf mines on *Trollius europaeus* (NN8967), V.C.89, 13/9/97, KPB.

P. trolliophila Hering. Glen Fender meadows, Perthshire, leaf mines on *Trollius europaeus* (NN8967), V.C.89, 13/9/97, KPB. Both the above species share the globe flower as their host and are newly recorded for Scotland.

ANTHOMYIDAE

Chirosia flavipennis (Fallén). Fungarth Wood, Perthshire, puparium found in bark crevice but larval foodplants normally ferns (NO0343), V.C.89, 26/2/97, DMR.

HYMENOPTERA

PTEROMALIDAE

Gyrinophagus aper (Walker). Speybank, Inverness, emerged from a cocoon of the neuropteran sponge fly *Sisyra fuscata* (see above) that was found under loose alder bark (NH8506), V.C.96, 13/4/97, EGH. This parasitoid wasp was identified by Dr R.R. Askew and appears to be the first record for Scotland and one of very few for the British Isles as a whole.

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GLASGOW NATURALIST Vol. 23 Part 4 pp.59-64 (1999)

SUPPLEMENT (PART 2)

ON THE WILDSIDE

THE NATURAL HISTORY OF THE GLASGOW BOTANIC GARDENS

The first parts of this account of the natural history of the Glasgow Botanic Gardens were published in the previous issue of the Glasgow Naturalist 23(3), 40-56. They resulted from a period during which the Society promoted visits by members and others to the Gardens for the purpose of discovering the wild plants and animals that live there. It is intended to bring together all these accounts in a separate booklet for sale to visitors to the Gardens. This would complement those existing publications that provide a guide and describe the planted features.

HIDDEN WILDLIFE: THE RESIDENT POPULATION OF INVERTEBRATES

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Within any area of land, water or air there is an abundance of wildlife, much of which is so small that it either goes unnoticed or is simple referred to as 'creepy-crawlies'. This mass of wildlife is regarded by some as of little value or actually harmful. It is certainly the case that the few notorious ones, the pests, give the rest a bad name. However, without the huge numbers of insects, worms and other invertebrates there would be no food chain to support the larger animals. Similarly, the health of the soil relies partly on the invertebrates breaking down dead leaves and other organic remains to create a medium in which plants can grow.

In the Botanic Gardens there is an unusual extra element to be examined by those with sufficient time or curiosity. This is the number of non-native insects and other invertebrate animals that are able to survive because of the maintenance of hot-houses and other horticultural activities. These alterations in local conditions combined with the international movement of plants are necessary for the management of a large exotic collection. As a result a number of aliens, accidentally introduced and temporarily or permanently established, can be found. Most of these also are harmless, but one or two gain a bad press and become infamous, such as the New Zealand Flatworm.

This account highlights some of the interesting invertebrates that have been seen in the Gardens. The introduced species are distinguished from the natives by [A] following their name. A list of the total number of invertebrates found would be long and consist almost entirely of unfamiliar latinised biological names. As many of these small creatures do not impinge on the human consciousness they have not achieved the status of gaining a more 'user-friendly' common name in any other language. Some commentary accompanies each section or individual species of interest. Further details exist on file and are available to anyone interested who wishes to contact the Society. The majority of the data were gatherered during the four years from 1994-1998 on outings of the Glasgow Natural History Society, sometimes jointly with the Friends of the Botanic Gardens. However, records of the alien species had been given a considerable boost locally in March 1988 when a number of people investigated all the various parks and hothouses in Glasgow. These were Adrian Rundle, who produced the manuscript list of those found, in the company of David Guntrip, Beryl Rands, Geoff Hancock, Fred Woodward and Richard Sutcliffe. The population of some of the established aliens inside the glasshouses has fallen noticeably in recent years. This is probably due to a change in the management of potted plants, with gravel and plastic being used as a base on the staging, which provides less suitable habitats for the animals. Undoubtedly, as a proper approach to growing rare and delicate plants this is of great benefit but there is less 'wildlife' as a result.

It seems clear that extra effort would boost the records of invertebrates from the Gardens considerably. This account should be seen as a preliminary attempt at assessing the diversity of the local fauna.

List of some invertebrates found in the Glasgow Botanic Gardens

PROTOZOA

Sprirostomum sp. In wildlife pond, 7/1994, AW.

Stentor sp. In wildlife pond, 7/1994, AW.

Vorticella sp. In wildlife pond, 7/1994, AW.

(?) *Carchesium* sp. In River Kelvin from the footbridge to below Queen Margaret's Drive bridge, 7/1994, AW.

COELENTERATA

Hydra (prob. *oligactis*). River Kelvin between the footbridge to below Queen Margaret's Drive bridge, 7/1994, AW.

PLATYHELMINTHES

TRICLADIDA
(terrestrial flatworms)

Artioposthia triangulata (Dendy) (New Zealand flatworm). [A] Commonly seen on most visits to the gardens, both around the glass houses and in the less managed areas where it can be found under stones, dead wood and litter. This interesting animal, a native of New Zealand, has been known to exist in Scotland for some time (Wakelin & Vickerman, 1979).

Bipalium kewense Moseley (Kew flatworm). [A] Found inside Ewing Range and the quarantine houses as well as public areas, 12/3/1988, AR; young one in Palm House, 25/3/1988, DB. Occasionally seen since then inside the Ewing Range and two found under plant pots out of doors near the Quarantine Houses, 18/11/96, EGH & GBC. These may have made their own way there during the warmer months but this species is not generally considered hardy out of doors in Scotland.

(aquatic flatworms)

Polycelis (?) nigra In River Kelvin, 7/1994, AW.

Dendrocoelom lacteum (Mueller) common on dead branches, etc., in River Kelvin, 7/1994 and 7/1995, AW & EGH.

PORIFERA (sponges)

Ephydatia (= Spongilla) fluviatilis (Linn.) (river sponge). Growing on dead branches, etc., in River Kelvin, 18/7/1995, EGH. Sponges and the moss animals (below) are groups that occur extensively in the sea of which a few members have evolved adaptations to freshwater habitats.

BRYOZOA (moss animals)

Fredericella sultana (Blumenbach). General appearance and simple oval sessoblasts seem to indicate this species but they are difficult to distinguish. Growing on surface of dead wood and debris in River Kelvin, 18/7/1995, AW & EGH.

ANNELIDA (worms)

TUBIFICIDAE

Tubifex (?sp.) In the pond near the Kibble Palace, 21/6/1994, EGH & AW.

NAIADIDAE (freshwater worms)

Stylaria sp. Found among sponges, etc., in River Kelvin, 18/7/1995, EGH. Evans (1910) records *Stylaria lacustris* (L.) as common in the Forth area and included a record of it from the pond in the Royal Botanic Garden, Edinburgh, October 1905.

MOLLUSCA (snails)

SPHAERIDIIDAE (pea mussels)

Sphaerium (?) corneum (Linn.). River Kelvin between footbridge to below Queen Margaret's Drive bridge, 7/1994, AW.

ANCYLIDAE (river limpets)

Ancylis fluviatilis (Müller) (River Limpet). River Kelvin between footbridge to below Queen Margaret's Drive bridge, 7/1994, AW.

ELLOBIIDAE

Carychium tridentatum (Risso). Kibble Palace (extracted from leaf litter) and Filmy Fern house, 12/3/1988, AR, common; 13/3/1988, DB; two empty shells and one live example on wooded slopes (Plot 169), 18/11/96, GBC; near old railway station, EGH.

PHYSIDAE

Physa fontinalis (L.). Old lily tanks according to label on specimens in Glasgow Museums (Acc. no. Z42.22am); in pond in wildlife garden, 17/5/1994, AW & EGH.

VALLONIIDAE

Vallonia pulchella (Müller). Orchid House, several shells, 12/3/1988, AR.

PLEURODISCIDAE

Pleurodiscus balmei (Potiez & Michaud). [**A**] Orchid House, 12/3/1988, AR, one shell; 16 August 1994, EGH, two live shells under stones; Filmy Fern House, 12/3/1988, AR, one old shell. The occurrence of this species, a native of the western Mediterranean, in Glasgow is referred to in Kerney & Cameron (1979).

ENDODONTIDAE

Helicodiscus parallelus (Say). [**A**] Filmy Fern House, 12/3/1988, AR, one live, three broken shells. An alien species, native to North America.

H. singleyanus (Pilsbry). [**A**] Filmy Fern House, 12/3/1988/, AR, one shell, an alien species.

Discus rotundatus (Müller). Filmy Fern House, 12/3/1988, AR, frequent; Orchid House, 16/3/1988, EGH, one live specimen; wildlife garden, 17/5/1994.

ARIONIDAE (slugs)

Arion ater (Linn.). Common around plant pots near cold frames, 18/11/86, EGH.

Arion circumscriptus Johnston. In wildlife Garden, 17/5/1994, AW & EGH.

A. distinctus. Kibble Palace Temperate House No. 4, a few live ones, Quarantine House, 12/3/1988, AR; Wildlife Garden, 17/5/1994, EGH; one example in leaf litter in wooded area (plot 169), 18/11/96, GBC. This species is distinguished by its yellow slime trail.

A. fasciatus (Nilsson). One example in wooded area (Plot 169), 18/11/96, GBC.

A. hortensis Ferussac. One seen in Conservatory No. 1, 12/3/1988, AR.

VITRINIDAE

Vitrina pellucida (Müller). One empty shell in leaf litter on wooded slopes (Plot 169), 18/11/96, GBC.

ZONITIDAE

Oxychilus cellarius (Müller). In wildlife garden, 17/5/1996, EGH.

O. draparnaudi (Beck). Orchid House and Filmy Fern House, 12/3/1988, AR, frequent; Kibble Palace, 13 March 1988, DB; one empty shell in leaf litter on wooded slopes (Plot 169), 18/11/96, GBC.

Zonitoides arboreus (Say). Tropical fern House, one shell, Temperate House No.4, frequent and Quarantine House, 12/3/1988, AR.

Z. excavatus (Alder). Orchid House, one old shell, and Temperate House No.4, several specimens, 12/3/1988, AR.

LIMACIDAE (slugs)

Limax maximus (Linn.). In wildlife garden, 17/5/1994, EGH.
Lehmannia valentiana (Ferussac). [**A**] Temperate House No.4,

three specimens; Kibble Palace, one juvenile, 12/3/1988, AR. An alien species, native to Spain and Portugal.

Deroceras laeve (Müller). Palm House, Temperate House No.4, Ewing Range and Kibble Palace, 12/3/1988, AR; three examples in wooded area (Plot 169), 18/11/96, GBC.

D. caruanae (Pollonera). Temperate House No. 4, 12/3/1988, AR, common.

D. reticulatus (Müller). In wildlife garden, 17/5/1994, EGH.

EUCONULIDAE

(?) sp. [A] Orchid & Quarantine House, 12/3/1988, AR, one shell in each greenhouse.

SUBULINIDAE

Subulina striatella (Rang). [A] Palm House and Ewing range, one shell in each, Orchid house, shells frequent, 12/3/1988, AR; Ewing Range, 25/3/1988, DB, several mature but dead shells; six live shells, subsequently found to have at least a dozen eggs, under staging in the middle section under plastic sacks and wooden planks or other debris, 16/8/94, EGH; three empty shells in Ewing Range, 18/11/96, EGH & GBC.

Subulina octona (Bruguière). [A] A specimen under this name from the Botanic Gardens, Glasgow, was exhibited at a meeting of the Conchological Society of Great Britain (Frew, 1906). The status of most older records of this species is in doubt as other members of the genus can be easily mistaken for it (Kerney & Cameron, 1979).

HELICIDAE

Helix aspersa Müller. One of the common garden snails was found by a cold frame, 18/11/96, EGH. Possibly due to the lack of lime locally, this is not a common species within Glasgow.

CRUSTACEA

OSTRACODA

Cypris laevis (Müller). Found in tank with Victoria Lily, 27/6/1869, according to label on specimens preserved in the Robertson collection, Glasgow Museums, Acc. no. Z1902-168-ql(1-2).

CLADOCERA (water fleas)

Daphnia hyalina Leydig. In pond in wildlife garden, 17/5/1994, AW.

ISOPODA (woodlice or slaters)

Soil-dwelling woodlice seem particularly able to survive transportation from one country to another and survive. This feature is shared with the millipedes and is reflected in the proportion of aliens in the list of those seen during this survey. In some cases they have spread so often and so far in association with human activities that it is almost impossible to say which country or area is their original native home.

Oniscus asellus Linn. (common shiny slater). Frequent everywhere and found on all occasions.

Porcellionides pruinosus (Brandt). Common; 11 June 1987 (EGH).

Haplophthalmus mengei agg. (Zaddach). [A] Kibble Palace, common in soil at base of *Strelitzia nicolai* plant, 12/3/88, AR. This species is native to central and southern Europe.

Androniscus dentiger Verhoeff. Kibble Palace, 12/3/88, AR.

Trichoniscus pusillus (Brandt). Kibble Palace, 12/3/88, AR.; common in soil and compost around glass houses and leaf litter on river bank, 18/11/96, GBC & EGH.

Porcellio scaber Latreille. Tropical Fern House, 12/3/88, AR.; in wildlife garden, 17/5/1994.

Trichorhina tomentosa (Budde-Lunde). [A] Palm House, two specimens, 12/3/88, AR.

Cordioniscus stebbingi (Patience). [A] Kibble Palace, several; Filmy Fern House, two specimens, 12/3/88, AR. This small woodlouse was first discovered by Alexander Patience, a member of the Glasgow Natural History Society, and described as new to science on the basis of specimens found in Glasgow (Patience, 1907). He said that he 'first met with this species in a field near Alexandra Park, Glasgow (and) subsequently in one of the propagating houses in the Botanic Gardens'. Probably originally native to Spain, Portugal and the Azores.

Asellus aquaticus Linn. (water louse). In pond in wildlife garden, 17/5/1994, AW.; River Kelvin between footbridge and to below Queen Margaret's Drive bridge, 7/1994, AW.

ARACHNIDA (spiders, etc)

ACARI (mites)

ERIOPHYIDAE

Eriophyes tiliae Nalepa. Galls on lime leaves, 20/9/1994, EGH.

PSEUDOSCORPIONES

Chthonius tetrachelatus (Preyssler). On specimen seen in Palm House, 12/3/88, AR.

ARANAEA (spiders)

Achaearanea tepidariorum (C.L. Koch). [A] Ewing Range, several females in webs by windows, 16/8/1994, EGH. An old Gardens record of this species is represented by 5 specimens in the H.C. Young collection in Glasgow Museums (Acc.no.Z1986.25.322), dating from the late1870s. In the north of Britain this species is not considered able to survive out of doors over winter. *Olios (=?Palystes) castaneus* Latreille. [A] Found in a propagating frame, February 1863, according to label on specimen in Glasgow Museums but with no other details. This is a kind of 'banana spider' which may have been accidentally introduced with some product from Africa. *Meta merianae* (Scopoli). In old railway tunnel and underground disused station 20 June 1995.

OPILIONES (harvest spiders)

Nemastoma bimaculatum (Fabr.). In wildlife garden, 17/5/1994, EGH.

Mitopus morio (Fabr.). One specimen in leaf litter on wooded slopes (Plot 169). 18/11/96, GBC.

SYMPHYLA

Hanseniella caldaria Hansen. [A] Symphylans are a group of tiny animals that look like baby millipedes. This species was recorded in the gardens (Bagnall, 1913b) and is known from similar heated glass house situations in Europe. It is thought to be native originally to South America.

MYRIAPODA

DIPLOPODA (millipedes)

Oxidus gracilis (C.L. Koch). **[A]** Common in all glass houses. This is now a cosmopolitan hothouse species and is thought to be native to eastern Asia originally. It has been known to live in the Gardens for most of this century (Bagnall, 1913b).

Choneiulus palmatus (Nemec). **[A]** Common in Palm House & Orchid House; Kibble Palace; Temperate House No. 4, under *Hydrocotyle asiatica*, 12/3/88, AR. This species was first recorded, as *Blaniulis pulchellus* Koch, (Bagnall, 1913a, b) from the Botanic Gardens, Glasgow, this being one of the earliest records for the British Isles.

Blaniulus guttulatus (Bosc). Kibble Palace; Palm House; Filmy Fern House, frequent, 12/3/88. AR.

Cylindroiulus britannicus (Verhoeff). Kibble Palace; Palm House, one specimen, 12/3/88. AR.

C. punctatus (Leach). Kibble Palace, one specimen, 12/3/88. AR.

C. vulnerarius (Berlese). **[A]** Kibble Palace, two adult males, one juvenile in soil at base of Strelitzia nicolai plant, 12/3/88. AR. This is one of the more recent additions to the British millipede fauna and appears to be the first notice of it in Scotland. Native to Italy.

Nopoiulus kochii (Gervais). **[A]** Filmy Fern House, one specimen, 12/3/88. AR.

Prosopodesmus (?sp.) **[A]** Palm House, common under slates; pair seen mating, 25 March 1988, DB. Identity of this species not established but there are two known to be widely spread throughout the world by human agency.

CHILOPODA (centipedes)

Dicellophyllus carniolensis (Koch). **[A]** Recorded in the Gardens by Bagnall (1913b), this centipede is native to central Europe but has not managed to establish itself in Britain.

Cryptops hortensis (Leach). Kibble Palace, 12/3/88. AR.

Lithobius forficatus (Linn.) Kibble Palace & Quarantine House, 12/3/88. AR.; several under logs and stones in wildlife garden, 17/5/1994, EGH.

L. melanops (Newport). Palm House (several), Orchid House & Quarantine House, 12/3/88. AR.

Lamycetes fulvicornis Meinert. Kibble Palace, one specimen, 12/3/88. AR.

INSECTA

DICTYOPTERA (cockroaches)

Periplaneta australasiae (Fabr.) (Australian cockroach). This species is common and can be seen in most of the glasshouses, especially the Palm House, to the exclusion of the American cockroach, *Periplaneta americana* (Linn.).

HEMIPTERA - HETEROPTERA (bugs)

Acanthosoma haemarrhoidale (L.) (hawthorn shieldbug). Several on birch trees, 3/10/1996, KPB.

Elasmostethus interstinctus (L.) (birch shieldbug). Several on birch trees, 3/10/1996, KPB.

HEMIPTERA - HOMOPTERA (greenfly, leaf hoppers, etc)

PSYLLIDAE

Psyllopsis fraxini (Linn.). Galls on leaflet edges of Weeping Ash, 3/10/96, and other ash trees, 20/9/1994, EGH.

ADELGIDAE

Adelges laricis Vallot. (pineapple gall aphid). Previous year's galls on Sitka Spruce in David Douglas garden, 19/4/1994, EGH.

EPHEMEROPTERA (mayflies)

Cloeon dipterum (Linn.). In wildlife garden, 17/5/1994, AW.

NEUROPTERA (lacewings)

Hemerobius micans Olivier. One adult at rest on lime tree twig, 20/9/1994, EGH.

TRICHOPTERA (caddisflies)

Setodes argentipunctella McLachlan. In wildlife garden, 17/5/1994, AW.

Glyphotaelius pellucidus (Retzius). In wildlife garden, 17/5/1994, AW.

Arthripsodes aterrimus (Stephens). In wildlife garden, 17/5/1994, AW; larval cases and adults in and around pond near Kibble Palace, 21/6/1994, EGH.

LEPIDOPTERA (moths and butterflies; arranged according to checklist in Bradley, 1998)

14 *Hepialus humuli* Linn. (Ghost moth) freshly emerged, in arboretum, 21/6/1994, per John Lyth.

150 *Adela reaumurella* (Linn.) In wildlife garden, 17/5/1994, EGH.

285 *Caloptilia azaleella* (Brants) (Azalea leafminer). **[A]** Reared from blister mines on Azalea leaves (RKJ) and may be the only known occurrence of this species in Scotland. It is relatively common in the south of England, and originally native to Japan.

427 *Yponomeuta cagnagella* (Hübner) (Spindle ermine). Adult flying and larva on nearby *Euonymus* bush, 20/8/1996, EGH & RKJ.

1042 *Acleris rhombana* (D. & S.) (Rhomboid tortrix). One attracted to light inside Kibble Palace, 20/8/1996, EGH.

1304 *Agriphila straminella* (D. & S.). Adults flying early evening, 20/8/1996, EGH & RKJ.

1305 *A. tristella* (D. & S.). Two adults inside Kibble Palace, 20/8/1996, EGH & RKJ.

1777 *Hydriomena furcata* (Thunberg) (July highflyer). Adult flying at dusk, 20/8/1996, EGH.

1906 *Opisthograptis luteolata* (Linn.) (Brimstone). Adult flying at dusk, 20/8/1996, EGH.

2107 *Noctua pronuba* Linn. (Large yellow underwing). Adult flying at dusk, 20/8/1996, EGH.

2441 *Autographa gamma* (Linn.) (Silver Y). Adults common at dusk on flowers in herb garden, 20/7/1996, EGH & RKJ.

COLEOPTERA (beetles)

CARABIDAE (ground beetles)

Agonum assimile (Paykull). Data from specimen in Hunterian Museum (Zoology), 28/3/1965, J. Brock.

DYTISCIDAE (diving water beetles)

Ilybius fuliginosus (Fabr.). Two adults in the pond near the Kibble Palace, 21/6/1994, EGH & AW.

Acilius sulcatus (Linn.). Larvae seen in the pond near the Kibble Palace, 21/6/1994, EGH & AW.

Dytiscus (?sp.). Larvae in the pond near the Kibble Palace, 21/6/1994, EGH & AW.

STAPHYLINIDAE (rove beetles)

Staphylinus olens (Müller). (Devil's coach horse), wildlife garden, 19 April 1994.

COCCINELLIDAE (ladybirds)

Propylea quattuordecimpunctata (Linn.) (Fourteen-spot ladybird). One on lime tree, 20/9/1994, EGH.

Adalia bipunctata (Linn.) (Two-spot ladybird). Lots congregating under sycamore bark preparing for hibernation, 20/9/1994, EGH.

A. decempunctata (Linn.) (Ten-spot ladybird). Adult at rest on lime leaf (earlier in the season all the ladybirds on this tree were bipunctata) 20/9/1994, EGH.

Anatis ocellata (Linn.) (Eyed ladybird). One adult in leaf litter under pine tree, 18/11/1996, JH.

CERAMBYCIDAE (longhorn beetles)

Bardistus cibarius Newman. **[A]** Two adult beetles emerged from stump of *Xanthorrhoea* sp. (grass tree) after it had died in the Kibble palace, 12/6/1996, PM. The beetles are native to Australia (Duffy, 1963) and were probably present as grubs inside the tree when it was imported and planted about 18 months earlier.

CHRYSOMELIDAE (leaf beetles)

Phyllodecta vitellinae (Linn.) (Willow leaf beetle). Common on Salix sp. at pondside; larvae and egg masses and feeding damage also seen, 21/6/94, EGH.

DIPTERA (flies)

TIPULIDAE (long-palped craneflies)

Tipula (Tipula) oleracea Linn. In wildlife garden, 17/5/1994, EGH. One of the 'leatherjacket' species whose grubs damage roots of plants in gardens and farmland.

T. (Savtshenkia) staegeri Nielsen. One on leaf near railway tunnel, 20/9/1994, EGH. This group of craneflies have larvae that feed on mosses growing on the surface of tree trunks and rocks.

LIMONIIDAE (short-palped craneflies)

Dicranomyia mitis agg. (Meigen) Kibble Palace, common swarming insect which can be seen flying most days inside the Kibble Palace and is common out of doors also.

Symplecta stictica (Meigen). One seen inside Kibble Palace, 20/8/1996, EGH.

Gonomyia lucidula de Meijere. One adult male near the pond by the Kibble Palace, 21/6/1994, EGH & AW.

CECIDIOMYIDAE (gall midges)

Contarinia tiliarum (Kieffer). Galls on common lime leaves, 3/10/1996, EGH.

Dasineura tiliae (Shrank). (Common leaf blade gall midge), in galls on common lime leaves, 3/10/1996, EGH.

BIBIONIDAE

Dilophus febrilis (Linn.) (fever fly). Several seen in wildlife garden, 17/5/1994.

Bibio leucopterus (Meigen). One male in wildlife garden, 7/1988.

B. marci (Linn.) (St Mark's fly). One male in wildlife garden, 7/1988.

B. reticulatus Loew. One male in wildlife garden, 7/1988.

CULICIDAE (mosquitoes)

Culex pipiens L. Female inside Kibble Palace, 20/8/1996, EGH.

ANISOPODIDAE (window gnats)

Sylvicola cinctus (Fabr.). One inside Kibble Palace, 20/8/1996, EGH. This fly has been reared from sap runs on the horse chestnut trees that line the Great Western Road. However, it is a widespread species feeding on a variety of rotting materials.

S. punctata (Fabr.) Adults at rest on trees and leaves, 20/9/94, EGH. This fly is normally associated with the dung of herbivorous domesticated mammals and so might have been introduced in manure.

STRATIOMYIDAE (soldier flies)

Beris chalybeata Forster. One male in wildlife garden, 17/5/1994, EGH.

SYRPHIDAE (hoverflies)

Melanostoma mellinum (L.). Several specimens inside Kibble Palace, 20/8/1996, EGH.

M. scalare (Fabr.). One inside Kibble Palace, attracted to lights at night, 20/8/1996, EGH.

Syrphus ribesi Linn. One at rest on leaf in wildlife garden, 17/5/1994; later in the year this species became very common, 20/9/1994, EGH.

Merodon equestris (Fabr.) var *validus* Meigen. (large bulb fly). Seen in Botanic Gardens, June 1915 (Ross, 1915). The maggots of this species attack the bulbs of daffodils, tulips and similar plants. It is undoubtedly still present and is generally common in gardens where spring-flowering bulbs are planted. The adult flies mimic bumblebees and occur in a number of varieties, each resembling a different kind of bee.

AULACIGASTRIDAE

Aulacigaster leucopeza (Mg.). Reared from sap run on horse chestnut tree, 18/7/95, EGH. This species is characteristic of this habitat and has been recorded from urban situations before in Sheffield, for example (Robinson, 1953).

AGROMYZIDAE

Phytomyza ilicis Curtis (holly leafminer). Leaf mines on holly, 20/9/1994, EGH.

HYMENOPTERA

CYNIPIDAE (gall wasps)

Biorhiza pallida Olivier. (oak apple bud gall). On oak on north of river bank, 19/6/1994, KW.

Neuroterus quercusbaccarum (Linn.). (spangle gall wasp). On oak leaves, near systematic beds, 20/9/1994, EGH.

FORMICIDAE (ants)

Paratrechina vividula (Nylander). **[A]** 'Botanic Gardens, Glasgow' according to label on 7 specimens mounted on one card in Glasgow Museums' collections, probably ex J.R. Malloch and dating to about 1907.

Tetramorium sp. **[A]** Palm House, abundant, several nests;

Orchid House & Quarantine House.

SPHECIDAE

Crossocerus megalocephalus (Rossi). A nest of this solitary wasp was found in old railway sleepers at end of range below the Ewing Range, 31/8/1995, JL. This species is known to make use of dead wood previously bored by beetles and lives colonially.

CONTRIBUTORS

Keith Bland (KPB); Gordon B. Corbet (GBC); David Beaumont (DB); E. Geoffrey Hancock (EGH); Jeannine Hazelhurst (JH); Robin Knill-Jones (RKJ); Paul Matthews (PM); John Logan (JL); Adrian Rundle (AR), who investigated the fauna inside the glasshouses and produced a manuscript list of those found on 12/3/1988 in the company of David Guntrip, Beryl Rands, Geoff Hancock, Fred Woodward, Richard Sutcliffe; Avril Walkinshaw (AW); Keith Watson (KW).

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SHORT NOTES

Compiled by A. McG. STIRLING

BOTANICAL

Danish Scurvygrass - Another Seaside-Roadside Plant in Lanarkshire

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The first record for Danish Scurvygrass (*Cochlearia danica*) in Lanarkshire (VC 77) was from a roadside at Flemington in 1989 and we now have 17x1km square records, 14 of which were made in 1998. One site was at a roadside as above, two at vehicle parks and the others along motorways. One record is from the M8, three along the M73 and 10 along the M74. With one exception the motorway sites were on the central reservations.

The plant is also abundant along the M8 to the east of Glasgow (Renfrewshire, VC 76), particularly in the region of the airport and along the M898 and A898 leading to the Erskine Bridge where we confirmed the presence of the plant by obtaining permission to record in the central reservation.

In a previous paper (Macpherson & Macpherson 1998) we reported on the occurrence of the seaside plant Lesser Sea-spurrey (*Spergularia marina*) along roads in Lanarkshire. Recording of this species is most easily carried out from midsummer to autumn while Danish Scurvygrass is most easily detected from spring to early summer when the clumps form patches of pale lilac which can be detected from a moving vehicle.

We had originally assumed that the occurrence of these plants was due to the sand/salting of roads in winter, the seeds having come in the sand and the salt providing a saline habitat and also discouraging the growth of other vegetation. However, when we enquired at the three main roadworks depots in Lanarkshire we were assured that seaside sand had never been used in the county. The sand comes from either the neighbourhood of the Glasgow Zoo or from Larkhall and the salt from an island site in Cheshire. We were surprised to learn that the large brown heaps which one sees at depots are actually salt and not sand.

Coombe (1994) considered that *C. danica*, unlike most of the other "maritime plants" of roadsides, required good drainage in a fine sandy or gravelly soil in which seeds can germinate and where summer drought reduces the competition from other plants. Salt *per se* was not necessary but did help to reduce the competition. He considered it possible that the plant was originally introduced with coastal shingle used in roadway construction.

We are grateful to Drs R. W. M. Corner and A. J. Silverside and to Messrs A. McG. Stirling and G. Walker for supplying records and to Professor J. H. Dickson for drawing our attention to a related article.

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Primula juliae established in Lanarkshire

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While recording to the east of Crawford, Lanarkshire (VC 77) in June 1995 we saw a large mat of *Primula* on a steep damp rock face near Camps Reservoir (Front cover). The vertical height of the patch was eight feet and the width five feet. There were also a few satellites. We have returned to the site on a few occasions when there was more flower on the plant.

In order to ascertain the history of the plant, enquiries were made of the reservoir staff. One member had worked at the site for 26 years and had no knowledge of anyone planting the *Primula*. All were in agreement that it had first been noted about ten years previously and had been spreading gradually each year. They all assumed that it was of spontaneous occurrence.

In order to obtain a specific name, dried specimens and live rooted material were sent to a number of individuals but they were unable to provide a definitive answer. Eventually in 1998 we learned that Dr A. J. Richards of Newcastle University was a specialist in the genus and when provided with a specimen he had no hesitation in naming it *Primula juliae*, a native in the rocky mountain forest of the eastern Caucasus. The plant was discovered by and named after the first female professor of botany, Julia Mlokosewischaya who led expeditions to the Caucasus around the turn of the century.

Dr Richards informed us that, although obtainable from a few specialist nurserymen, *P. juliae* is not common in cultivation, having been supplanted by its vigorous hybirds. When hybridised with *P. vulgaris* it gave rise to *P x pruhoniciana* grex, varieties of which are 'Wanda' and 'Blue Horizon' and with 'polyanthus' the Garryards, eg 'Guinevere', another favourite garden plant.

The flowers are all pin-eyed, but the plant is very stoloniferous, hence the spread on the rock face. The little separate plants must be of vegetative origin.

Primula juliae is not included by Clement & Foster (1994) in their catalogue of alien vascular plants. It is probable therefore, that this is the first record of the plant in the wild in the British Isles. There is no way of knowing whether this striking patch, in such an unlikely situation was deliberately planted, or whether a fragment was brought by (say) a bird. A specimen has been placed in herbarium PM.

We are grateful to Dr A. J. Richards for making the identification and for supplying the historical and horticultural information.

Alpine Bistort in Lanarkshire

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While recording in upland Lanarkshire (VC 77) in July 1998 we saw Alpine Bistort (*Persicaria vivipara*) on Gana Hill (26/95.01), just short of the boundary with Dumfriesshire (VC 72). The plant was in small quantity on grassland, just beyond a rocky outcrop at approximately 600m above sea level.

Alpine Bistort is a plant of grassland and rock-ledges on mountains, occurring particularly in the Highlands of Scotland and in northern England.

In the *Atlas of the British Flora*, Perring & Walters (1962) give three pre- and two post- 1930 records for the south of Scotland. The pre- 1930 occurrences were in Lanarkshire, Peeblesshire (VC 78) and at the boundary between Peeblesshire and Midlothian, while one post- 1930 record was at the boundary between Kirkcudbrightshire (VC 73) and Ayrshire (VC 75) and the other at the junction of Dumfriesshire, Peeblesshire and Selkirkshire (VC 79). All but one of these records are from relatively high ground. The source of the pre- 1930 record for Lanarkshire is the British Association Handbook (1901) which states "Falls of Clyde" without further information relating to localisation, year of discovery or name of recorder. In some respects it seems to be an unlikely site for the plant and therefore a dubious record. Our record is certainly the first for almost 100 years and might well be an actual new vice-county record.

Mackechnie (1958) considered it unlikely that spectacular botanic discoveries would be forthcoming in the future from Southern Upland Lanarkshire. However, Watson and Macpherson (1999) report three new vice-county records from that area and we consider it not unreasonable to claim Alpine Bistort as a fourth.

We are grateful to Messrs C. D. Preston and A. McG. Stirling for help in localising the previous records.

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Cape-gooseberry and Tomatoes on the shore near Helensburgh

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The shore at Craigendoran to the east of Helensburgh, Dunbartonshire, has proved in most years to be a good site for self-sown tomato plants resulting from sewage-borne seed. Several times in the late summer of 1998 a short stretch of shingle shore just west of Craigendoran Pier was examined. Tomatoes of shapes not usually found in the shops frequently occur along this coast, including rib-sided and small cherry types.

As the fruit ripened, one day an unusual plant was seen, and closer inspection revealed about nine similar individuals. Reference to 'Stace' seemed to point to its being *Physalis peruviana* (Cape-gooseberry) and this was confirmed by Mr Eric Clement to whom we sent a specimen. Like the tomato (*Lycopersicon esculentum*) the *Physalis* is a member of the Solanaceae. Another member of the genus is *P. alkekengi* (Japanese-lantern) introduced and grown here for its ornamental inflated calyces.

We have not traced any previous Scottish records.

Adder's-tongue Fern in Dunbartonshire

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Since moving to Milngavie three years ago we have been delighted by the appearance in our lawn of one plant of Greater Butterfly Orchid (*Platanthera chlorantha*) and an increasing number of Common Spotted Orchids (*Dactylorhiza fuchsii*) - five in 1997, eight in 1998.

In the spring of 1998, while hunting for further non-flowering orchid plants, I also discovered two specimens of Adder's-tongue (*Ophioglossum vulgatum*). My identification was confirmed by Prof. J. H. Dickson and seems to be the only known site in Dunbartonshire, VC 99. Unfortunately the larger plant had been damaged by my earlier attempts at keeping the grass under control, but we have now marked the area in the hope that the numbers will increase in years to come.

Our house was built about 19 years ago and what we are seeing appears to be a reversion to the previous natural flora.

A digenean parasite, *Diplostomum phoxini* (Faust, 1918), in the brain of minnows from Loch Morar, Inverness-shire

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This note reports the occurrence of a larval metacercarial stage of a digenean parasite in the brain of minnow, *Phoxinus phoxinus* L., from Loch Morar, Inverness-shire, Scotland's deepest loch at 630m with a length of 18km (56°55'N, 5°30'W). Thirty minnows (50-70 mm length range) were collected from the loch in July 1996 using bottle traps and transferred for display in aquaria at Mallaig Marine World.

Sixteen weeks following transfer (29 November 1996) fish were seen to swim erratically, had a dark appearance and began to die at the rate of 1 to 2 mortalities (c.3% of stock) per week. All fish had died from the metacercarial infection by 9 May 1997. Fish were examined using a x40 binocular microscope. Bacteriological samples were taken from the kidney. For histological investigation of gills and vital organs, material was fixed in 10% neutral buffered formalin, embedded in wax, sectioned at 5µm and stained in haematoxylin and eosin.

Gross and histological examination revealed the presence of the tapeworm *Ligula intestinalis* (L.) of up to 70 mm length in the body cavity of 5 of 7 minnows examined on 15 April 1997. No other parasites were seen in examination of fresh samples and no pathogens were identified from bacteriological inocula. Metacercariae (*Diplostomum* genus) were observed in the brain tissue, mainly the medulla oblongata, of all 7 minnows examined (100% prevalence), an average of 4.7±0.5 SD in each cross section (Fig. 1). From the histological material and fresh samples digeneans were identified as *Diplostomum phoxini* (Faust, 1918) (Barber & Crompton, 1997 a, b). Sectioned specimens had a mean length of 283±47 µm and breadth of 153+12µm. No pathology was seen in any of the other organs examined.

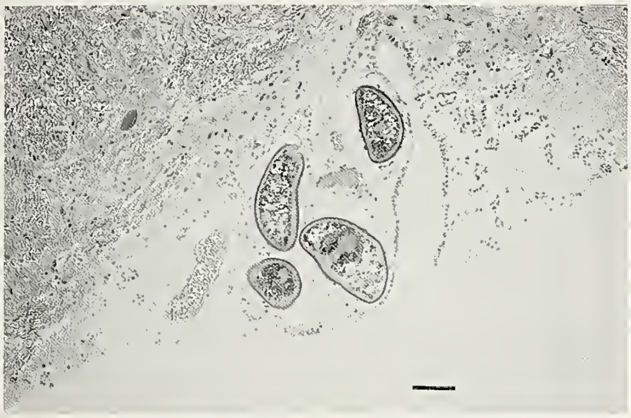

Fig. 1. Section through a brain of minnow showing *Diplostomum phoxini*. Scale Bar=100 µm.

Diplostomum phoxini was first recorded in the British Isles by Ashworth and Bannerman (1927) who described specimens from minnows from a stream near Edinburgh and Loch Lubnaig, Stirlingshire. Other records of *D. phoxini* in the British Isles (cited in Kennedy 1974) are from the River Clyde, Loch Leven, Loch Eck, Loch Lomond, Frogoch Lake, Wales, the Royal Canal and River Main, Ireland and the River Roding, Essex. The infection dynamics of *D. phoxini* were described in the R. Endrick, Stirling District and in Loch Maragan in the central highlands (Barber & Crompton, 1997 b). From examination of serial histological sections metacercariae of *D. phoxini* were found to be mainly distributed in the cerebellum, medulla oblongata and the optic lobes, areas implicated in the control of the host's antipredator response. This would enhance the possible of transmission to the final host.

The present record in minnows from the Scottish highlands indicates the wide distribution of the parasite in minnows in the British Isles. Minnows are the second intermediate host in the life cycle of *D. phoxini* and become infected when cercariae are released from the lymnaid snails and penetrate the fishes' skin (Barber & Crompton, 1997, a). Although a range of vertebrates has been used as definitive hosts, piscivorous birds, usually gulls (Laridae), are the main definitive host in natural habitats (Yamaguti, 1958) and these become infected by eating infected minnows. The adult trematodes produce eggs which pass with faeces from the host and, on hatching, free-living miracidia larvae are released, infecting snails, the first intermediate host (Barber & Crompton, 1997, b).

I am grateful to Ross Campbell and Sheila Henderson of Mallaig Marine World for providing samples and assistance during the study.

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Notes on the Marine Tardigrade *Megastygarctides seteloso* Morgan and O'Reilly, 1989

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The Tardigrades, or Water-Bears, comprise a phylum of minute arthropod-like animals common in aquatic environments or on the surface water film of terrestrial mosses. Marine species are relatively few in number with only 16 recorded from British waters. The tardigrade fauna of the Clyde Sea Area was described by Morgan & Lampard (1986) and a revised key to all Scottish (and UK) marine species was provided by Morgan & O'Reilly (1989).

The most recently described British species, *Megastygarctides seteloso*, is known only from the holotype male specimen collected in the Summer Isles, North West Scotland, in July 1985. The opportunity is taken here to provide notes on its discovery and to further illustrate aspects of its morphology based on a re-examination of the holotype.

The single specimen of *M. seleloso* was recovered from a scoop of surfaces and collected by a diver at 16 m depth in The Anchorage, Tanera Mor. The sampling was being undertaken as part of a programme to study benthic harpacticoid copepods, especially of the genus *Haloschizopera* (see Moore & O'Reilly 1989, 1993). The sample was fixed with 4% formaldehyde and subsequently elutriated onto at 45µm sieve. The elutriate residue was sorted, by the present author, on a stereo microscope to remove copepods and during this process a tiny tardigrade was noticed. This was sent to Clive Morgan who confirmed it as a new species of the genus *Megastygarctides*. Hitherto only two *Megastygarctides* species had been described, both from the Pacific Ocean: *M. orbiculatus* McKirdy *et al.*, 1976 from the Galapagos Islands, and *M. isounguis* Renaud-Mornant, 1981 from New Caledonia.

In view of this interesting find a thorough re-inspection of the sample residue was undertaken by Dr Morgan in 1986. Several specimens of another tardigrade, *Halechiniscus perfectus* Schula, 1955, were recovered, this species being previously unknown in Scottish waters, but no further specimens of *M. seteloso* came to light and none have been recorded since.

A full description of *M. seteloso* was provided by Morgan & O'Reilly (1989) accompanied by a morphometric comparison with the two Pacific species. However, the illustration contained a minor inaccuracy with respect to the positioning of the posterior clava and lateral cirrus A, and the dorsal view displayed only the posterior pair of legs. The arrangement of the clavae as well as the structure of the legs are critical taxonomic characters in tardigrades and for this reason the habitus of the holotype is re-figured to exhibit and clarify these features (Fig. 1).

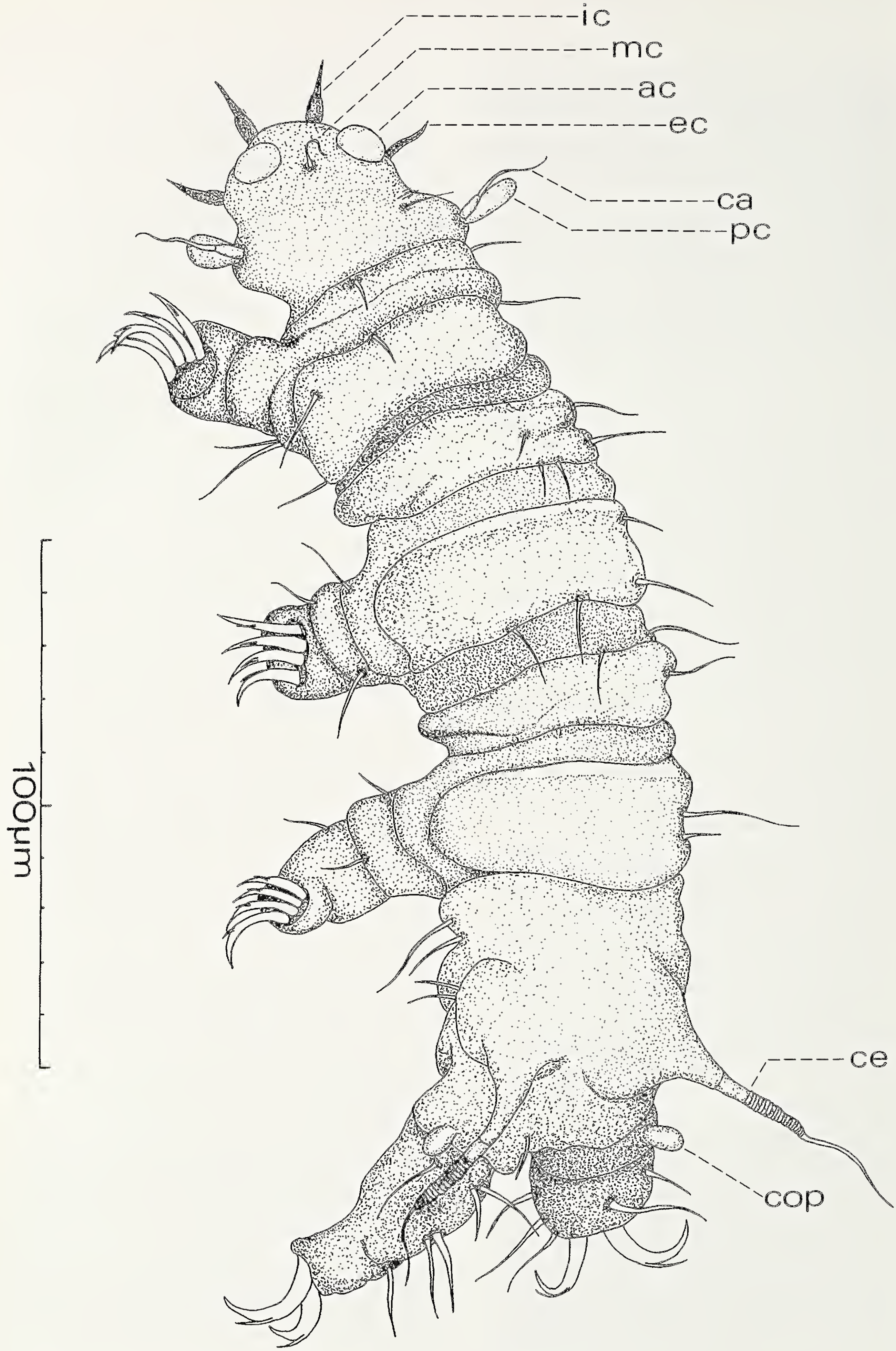

Figure 1 - ***Megastygarctides seteloso*** **holotype male**

(*ic* - internal cirrus, *mc* - median cirrus, *ac* - anterior clava, *ec* - external cirrus, *ca* - cirrus A, *pc* - posterior clava, *ce* - cirrus E, *cop* - coxal papilla)

The head hears a pair of internal cirri (*ic*) anteriorly, a pair of external cirri (*ec*) laterally and a single median cirrus (*mc*) dorsally. The anterior clavae (*ac*) are ovoid and placed dorsally on the head bearing a superficial resemblance to a pair of eyes. The cirrus A (*ca*) arises from the base of the posterior clava (*pc*). The previous illustration of Morgan & O'Reilly (1989) suggests that cirrus A is ventral to the clava. However, careful re-examination of the holotype indicates that, as in the Pacific species, the cirrus is in fact positioned dorsally to the clava.

The holotype specimen is presently mounted in a slightly skewed position. This enables observation of the forelegs on the left side and both rear legs. The combination of 4-clawed forelegs and 2-clawed rear legs is unique among British tardigrades. All the claws have a tiny accessory spur on the outer curve. The claws of the forelegs are, *in situ*, slightly tucked under the tip of the leg making detailed observation difficult. The foreleg claws have been illustrated here as if the leg tips have been slightly splayed upwards. The rear legs are figured with claws and bristles as observed. A small coxal papilla (*cop*) is situated towards the base of both rear legs.

The cuticular plate pattern of *M. seteloso* is similar to the type species with 3 principal body plates above the forelegs and a caudal plate posteriorly. The caudal plate carries a pair of long ciri E (*ce*), each with distinct annulations in the midpart and a long tapering flagellum. The plate boundaries are not entirely distinct, however, and the pattern is considerably confused by the occurrence of intervening accessory plates and cuticular folds producing overall a wrinkled appearance.

The body is ornamented with numerous bristles. All bristles observed under the present alignment of the holotype are included in the figure though it is possible that some may have been overlooked on account of their small size or orientation.

Elucidation of further details and variations of the morphology of *M. seteloso* await the discovery of new material.

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Further records of *Crangonyx pseudogracilis* (Crustacea: Amphipoda) in the Clyde catchment

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Crangonyx pseudogracilis, a freshwater member of the amphipod family Crangonyctidae, is a North American species which was first discovered in Britain in the 1930s in the London area (Gledhill *et al.*, 1993). It occurs now in most of England and Wales and has been recorded in several rivers in northeast Scotland and is common in Loch Ness (Gledhill *et. al.*, 1993). It resembles superficially small pale specimens of the common genus *Gammarus*, but can be distinguished by the obvious serration on the posterior edge of the leg-like pereopods 3-5.

C. pseudogracilis was first recorded in this area from the Black Cart Water in 1990 (Doughty, 1992) and was found in 1996 in Loch Lomond in littoral kick samples collected by our biologists as part of the Environmental Change Network programme coordinated by the Institute of Terrestrial Ecology. Most recently, it was recorded in January 1998 from the Avon Water just upstream of its confluence with the river Clyde near Hamilton, and in October 1998 from the Clyde at two locations in Glasgow: Carmyle and Dalmarnock.

In view of the successful spread of this species so far, we expect it will be found in other parts of the area in the future.

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Extension of the Ringlet butterfly's distribution in southern Loch Lomondside

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In early July 1997, Mr K. Ritchie reported finding a small colony of the Ringlet *Aphantopus herperatus* L. in tall grassland at the north end of Balloch Park NS390835. Prior to this discovery, the butterfly was only known in southern Loch Lomondside from roadside verges on the region's eastern fringe - the Muirpark NS488915 and the Bog of Ballat NS527903, distances of approximately 13 kms and 15.5 kms from the new site.

As the Ringlet has a slow, rather feeble mode of flight, not particularly well adapted to long distance dispersal, it seemed unlikely that the colonisation of Balloch Park was achieved in a single move. Accordingly, in the following year a search was made of suitable habitat at several places in the intervening area. Despite the persistently bad weather experienced during the butterfly's flight period in July 1998, Ringlets were found along the river bank of the Endrick below Balfron bridge

NS537881 and in some rough pasture known as the Whin Park NS434880 near the south-east corner of Loch Lomond. Both of these well separated localities had been visited by the writer on a number of previous occasions in the appropriate season without recording the species' presence.

It is worth adding that in the late 1970's, Thomson (1980) noted that the Ringlet had re-occupied some of its former haunts in the Glasgow area as part of a general expansion of the butterfly's range in Scotland.

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Malthinus seriepunctatus Kiesenwetter new to Inverness-shire, and records of other scarce Scottish Cantharidae (Coleoptera)

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Malthinus seriepunctatus has a broadly southern distribution in Britain, becoming much scarcer north of a line from the Mersey to the Wash. In Scotland, there are few published records and occasional museum specimens, all from the southern half of the country. However, beetles were swept in small numbers in Coille Mhailairigh, Glenelg (NG812122), VC 97 (West Inverness), 17.vi.1997, extending its known range northwards along the west coast considerably.

The main range of *Cantharis pellucida* penetrates further north than that of *M.seriepunctatus*, but the distribution begins to thin out significantly around the Clyde/Forth line. Further north there are a scatter of records along the west coast plus a concentration in the Spey Valley, but very few other records. My June 1997 visit to the west coast found the beetle to be plentiful in two important reserves of ancient semi-natural Caledonian oak woodland: Dalavich Oakwood (NM967135), 9.vi.1997, & Glen Nant (NN012297), 10.vi.1997, both VC 98 (Argyll Main).

There are remarkably few Scottish records for *Rhagonycha testacea* - the main part of its British range appears to stop around the borders, from whence there is only a thin scatter of modern records concentrated along the west coast, with a few older records further east. The species was, however, found to be plentiful in the damp ancient semi-natural woodland of Glen Nant (NN012297), 10.vi.1997, but was not found anywhere else.

Thanks go to all recorders who have made their records available to the Cantharoidea and Buprestoidea Recording Scheme.

Recent Records of the Giant Gad Fly in the North Clyde Area

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On 3 August 1996, a single Giant Gad Fly *Tabanus sudeticus* Zeller was observed at close quaters in an open part of Auchentorlie forestry plantation in the western Kilpatrick Hills. This was the first time I had encountered the largest member of the *Tabanidae* family of biting flies in Scotland, but it was quite unmistakable due to its exceptional size - the females up to 25 mm in length, with a wing span of nearly 50 mm - and an audible humming flight (Colyer & Hammond, 1968).

Later enquiry produced only a few previous records from the surrounding district: Glen Mallon on Loch Longside and Bonhill in the Vale of Leven (Grimshaw, 1901); an entry for Dumbarton in the Clyde Card Catalogue (*per* Geoffrey Hancock); Gartlea on the northern edge of Dumbarton Muir, where the late Iain Christie's field notebook mentions that he saw several specimens in early July 1975 (*per* Jane Christie).

In view of the paucity of localised records of the Giant Gad Fly for the North Clyde Area, it seems worthy of notice that the insect, which is troublesome to both man and beast, was reported from three widely scattered spots in 1998: Twenty Acre Meadow, in the lower flood plain of the River Endrick, 1 July (Colin Horne); Ardess, near Rowardennan, 13 July (Alasdair Eckersall) and the disused Dumfin Sand Quarry, Glen Fruin, 29 August (John Knowler & John Mitchell).

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Kingfisher on the River Kelvin in 1998

Brian S. Skillen
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A pair of kingfisher established on the River Kelvin in the vicinity of Kelvingrove late in 1997 and were active throughout 1998. The pair were seen in early spring and notably on the 24 March when they were flushed from their riverside hide during an attack by a sparrow hawk on grey wagtail working the Kelvin and which caused general widespread panic amongst local birds. During April, May and June there was much noisy activity along the river, often about the weir below the Art Galleries down to the outfall of the sewer from that property, about 50 metres upstream of the weir near Old Partick Bridge.

On the 22 June the weir was the site of an interesting encounter between Swifts which were flying close down to the river surface and a kingfisher. The early morning sighting began with watching the Swifts but soon a kingfisher came up the Kelvin carrying a fish. The kingfisher was flying almost on the same level as the Swifts and swerved to avoid a near miss with one. The kingfisher climbed sharply in flight towards Gilmorehill, flighing around and across where I stood and then back over the river to the east bank. It then flew along the pathway below the Art Galleries site and next to the Kelvin and disappeared, still with its fish, in the area of the outfall of the sewer.

A reason for so much noisy activity and fish carrying was revealed by early June 1998 when at least one young bird was seen on the river. On the 2nd July a young kingfisher was calling for attention in bushes near the bridge carrying Kelvin Way over the River Kelvin. The bird was seen both early morning and mid-day during which time it was attended regularly by both parent birds carrying small-fry. The young bird was watched bouncing up and down on a branch of a small tree next the river soliciting food.

Kingfisher acitivity continued during autumn and winter 1998 and another interesting display took place on 2nd October, when the presence of a remarkable dark grey heron on the river in the early morning, caused alarm and considerable vocal display from at least two kingfisher.

Kingfisher activity is not at the level of the early 1990s on the Kelvin but they maintain a presence and appear once more to be consolidating their territory about Kelvingrove. An interesting aspect of their activities is the interest they have generated in park workers and "hangers-on" about the west section of Kelvingrove. On several occasions small "social" groups gathered by the River Kelvin below Gilmorehill to see if they might see the kingfisher. On being questioned all were interested, helpful and knowledgeable about local park and river birdlife and happy to share their observations.

Great Spotted Woodpecker in Kelvingrove

Brian S. Skillen
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On Friday the 13th. March 1998 a Great Spotted Woodpecker was encountered in Kelvingrove Park about 07.40. A well marked male bird was watched for 20 minutes exploring and drumming about an ailing Willow tree close to the pedestrian bridge, on the bandstand side of the park. The bird was encountered again on the 20th. and watched in flight towards the Lord Robert's statue high on the hill above the park; it was heard but not seen on the 24th.

The bird was not encountered again until the 7th April when it was found working a tree close to the Kennedy statue of the Lioness and her cubs. The woodpecker was busy on a birr on the tree side and it kept working at it for a period until it stopped to preen. Preening was stopped after a period as the bird took alarm at other people in the park and the presence of other birds.

The woodpecker was encountered again on the morning of 16th. April busy preening, high on a tree in direct sunlight: after a time it flew to the Kennedy statue site. When watched at the Kennedy site the bird was knocking on the same area of the tree as noted above and dodging round and round the trunk, stopping and pressing against the bark as if listening. At this site the bird was regularly mobbed by blue tits.

The woodpecker was seen again on the 22nd. April at a perch site above the skateboard area of the park, where it was drumming against an upright stick branch, high in the tree. The bird was very jittery indeed and though it stopped to preen a careful watch was maintained at all times.

On the morning of the 23rd. the woodpecker was heard as if in the distance but lunchtime investigation revealed the reason for the odd beating note, for it was found starting a hole about 4 metres up the first tree on which it was sighted. The woodpecker was already able to get two thirds of its body into the hole suggesting that it had been busy for quite some period and accounting for the caution of the previous sightings. The woodpecker was watched from cover working the nest hole over several days and its pecking into the tree hole, then extracting its head to shake off saw-dust, was interesting to see.

On the 24th. another woodpecker appeared on site and the two birds indulged in their "tchicking" call and display for about 15 minutes.

Discussion with other people in the park suggested that the woodpeckers were ranging as far as Queen Margaret Bridge and generally very active, though not always seen. A possible reason for this was the woodpecker's obvious alarm at the presence of other birds such as magpie. On arrival of a magpie a woodpecker working at the tree hole was seen to cling in tightly to the tree trunk and remain static for a timed 10 minutes, after which time the magpie had flown off. Tree cutting activity from the 24th. April onward was another reason for increasing alarm for the woodpecker, but by the 25th. the woodpecker active at the tree hole were well in on the nest. All that might be seen on occasion was a tail, angled as the bird held its hammering and gouging position against the trunk.

The Kelvingrove encounters continued throughout April and into May with both woodpeckers being seen. The birds were regularly mobbed by other parkland birds, such as a mistle thrush on the 27th April. On the 1st. May there was an encounter between a woodpecker and a heron which caused great alarm to the former. On the 5th. May a small flock of starlings harried a woodpecker away from a perch site close to the south gate of Kelvingrove. Problems with other birds and a period of tree cutting in Kelvingrove led to the woodpecker "deserting" the tree hole in the park and a long period of their not being seen. But there was a reason for this and successful nesting somewhere in the valley of the Kelvin led to an encounter on the 25th. June with the two adult woodpeckers and a young bird, near the Carlyle Statue in Kelvingrove. Throughout late June and into early July all three birds were encountered at various locations throughout the parkland.

An interesting sighting of the young woodpecker was had on the 1st. July when it was watched working a tree branch low down. It is likely that the young bird found it easier to work along the branch for with its shorter juvenile tail the speedy movements up tree trunks achieved by the adults would have been difficult. That the length of the tail dictated the young woodpecker's activities at low levels on tree branches is supported by never having see the young woodpecker active on tree trunks, unlike the adults which could literally run up them. The shorter beak of the young woodpecker probably also accounted for its actions as the pronounced grooves and openings of the branch bark surface was more favourable to the young bird's probing beak and long tongue.

Woodpecker activity greatly reduced after July 1998 concomitant with an increase in troublesome magpie and grey squirrel. Adult greys were seen to chase the woodpecker in July where young squirrel were present in the thickets at tree bases where the woodpecker chose to land. A most unusual encounter between woodpecker and squirrel took place on one of the formers' "sentry trees" in which a juvenile squirrel had established. The grey squirrel spent much of its time tree hanging below the trunks of branches and wandering around in below the trunks of the branches to the seeming bewilderment of the woodpecker which scolded at it whenever it came near. Late season sightings included activity in September and November, the latter again of some interest as the bark structure of trees seemed so soft after the wet summer, that woodpeckers pecking on the trunks made no noise at all and were only spotted by their drumming head movements. Indeed tree bark was so weak that the woodpecker was able to lever off great strips with its beak and send the bark flying everywhere.

The woodpeckers were not seen by this observer after early November 1998 and it is likely they disappeared with colder weather. Exploration through Kelvingrove after November no longer revealed fresh "beak-work" an element to their discovery again in mid-autumn.

Approximately 10 hours or more of viewing woodpeckers was achieved in Kelvingrove, a parkland where the woodpeckers seem to have been little recorded before and 1998 was therefore a significant year for parkland bird life.

I acknowledge my mother, Carol Aitken, Sheila Russell and Richard Sutcliffe for assistance in recording the activities of the Great Spotted Woodpecker in Kelvingrove.

Sperm Whales (*Physeter macrocephalus*) in Scapa Flow, Orkney

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The Sperm Whale *Physeter macrocephalus* was rare in Orkney waters in the 19th century according to Buckley and Harvie-Brown (1891). It continued to be rare in the 20th century up until 1975, with only one definite record (Booth and Booth, 1994). Since then it has occurred more frequently with a number of both sightings and strandings, although some of the latter are of whales that have been dead for some time before coming ashore on Orkney. The majority of sightings have come from within Scapa Flow, an area of sheltered water well known as an anchorage for naval vessels in both First and Second World Wars and now used by oil tankers. Lying in the southern part of the Orkney archipelago, Scapa Flow extends for approximately 120 square miles, it has a maximum depth of 62 metres and a mean depth of approximately 35 metres.

The first report was in October 1976 when 6 or 7 whales were seen on several occasions, during one day, from an aircraft that was making flights across the Flow. The next sighting was again from an aircraft when a large whale, about 18 metres in length, was seen on 22nd September 1981; it was present for only a few hours. On 22nd February 1993, 6 whales arrived and stayed for several weeks. They were all thought to be immature males, 4 being about 15 metres in length and 2 slightly smaller. The whales spent their time within the deeper waters of the Flow, often resting with parts of their heads protruding above the water. From a distance they looked like large barrels floating on the surface of the sea. Their continued presence in the Flow became a cause for concern. Not only was there a risk of collision with shipping but also of accidental stranding. On 25th March a successful operation was launched, using a flotilla of boats to shepherd the whales out of Scapa Flow and into the Pentland Firth.

There were no more reports until 1998 when 7 were seen on 14th April. Varying in length between 11 and 15 metres, these were also thought to be immature males. They were still present on the 15th, so an attempt was made to monitor their movements. Unfortunately strong winds during the next few days made it very difficult to keep track of the whales, with even the sheltered waters of the Flow being rough. The last definite sighting was on the morning of the 21st April but it was not until the 24th that conditions were calm enough to carry out an aerial survey to confirm that the whales had left. It will be interesting to see whether Scapa Flow has any further visits from Sperm Whales in the next few years.

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An Otter at Cadder

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On the 28th. March 1998 I encountered an otter in the area of the old Roman Fort at Cadder. The otter was first seen on the opposite bank of the canal where it travelled about 50 metres, stopping and exploring parts of the bank and then hurrying on. It entered the canal eventually and surface swam out into the middle of the canal: to my surprise the otter swam towards me. I stopped walking along the canal bank and the otter landed and came up onto the bank about 4 metres from me and reared up, looking at me. It maintained this pose and sniffed the air. It did not appear to be put out by my presence, though it made a "chirping" noise. The otter then sat back down and stopped and continued looking in my direction. Eventually it sniffed the air again and after a soft whistle, it wandered past me and into the cover of grass and plantings. The encounter lasted ten minutes or more. At Cadder Fort the canal follows a course along the bank of the hill with a very steep descent to open farmland running across to the River Kelvin; it was later possible to watch the otter travel across the farmland to the Kelvin, going about its business.

Don Martin, Reference and Information Librarian for East Dunbartonshire Leisure & Cultural Services, reported seeing an otter on the Kelvin, about the Park Burn, Kirkintilloch, a week or so previous to my encounter and it may have been the same animal.

The otter was classical in appearance conforming in its general behaviour to the description available in texts such as Southern's "The handbook of British mammals" (1964). What was impressive was the otter's acceptance of my presence which was quite at variance to ill-tempered encounters with mink along the canal and in truth I was taken totally aback with this close encounter with an otter.

Parkland change and its impact on Grey Squirrel life in Kelvingrove

Brian S. Skillen
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The cutting down of trees and cover in Kelvingrove as part of attempts to rehabilitate the old park impacted on local life for squirrels. In June 1998 after several "clan" groups of related squirrels, identifiable by subtle differences in their markings, for example brown or white ear tips, were ousted from their hides by tree cutting, there was considerable territorial movement. Rival groups of squirrels clashed on a number of occasions and on 5th. June a fight took place between ten or more squirrels on the flat lands next the River Kelvin, just down stream from Eldon Street Bridge and opposite Westbank Quadrant. I watched the fight from higher ground over a period of time during which ritualistic display and fighting spread across the area with flanking attacks launched from the base of trees. But the arrival of a dog in the squirrels' midst stopped the fight as suddenly as it had begun and the squirrels fled.

Group activity amongst Kelvingrove squirrels continued to late June when in contrast to the "battle" a quite different display took place with five young squirrels displaced to the Honeyman memorial area. The squirrels were bouncing about in the undergrowth making a continual "chirring" note, during which time an elaborate game of chasing and jumping developed. The chase led right across my path and the squirrels paid little heed to me, literally running in my feet and into the long grass by the river bank of the Kelvin. The "chirring" continued as an old willow became the centre for an elaborate game of chasing round and round the trunk. At one point a squirrel dropped off and down into the long grass about the roots. The squirrel "chirring" loudly bounced out of the long grass and through the fence at my feet, only then realising that there were things other than squirrels abroad that morning and fled back into cover. The clamour of the squirrels continued as I left them to their pursuits about the long grass and trees.

Group activity amongst squirrels in general has been encountered before, notably a noisy session on Christmas morning December 1989, but the two very different incidents in Kelvingrove were of interest with local territorial changes due to tree felling late spring and early summer 1998.

The emergence of young squirrel also saw a change in pattern to other years. Juvenile animals often huddled in small groups about the larger old trees: during the summer months of 1998 the young were "parked" in dense undergrowth until attended by adult squirrel. The cover along the bank of the River Kelvin hosted many young squirrel, often observed when bird watching. The presence of squirrel in bushes seemed to cause more alarm than usual to parkland birds and why that may have been is not clear, though pressure for living space may have arisen with the felling of trees and cleaning out of scrub and cover over areas of the park.

Parkland change also saw greater caution on the part of Grey squirrel with humans: this may reflect a change in park clientele for the present. The closure of the children's play area for refitting meant there were fewer youngsters to feed the squirrel. Another reason for the shy behaviour of squirrel would appear to relate to the loss of cover for a quick get-away.

Kelvingrove suffered a lot in 1998 and the late season storm brought further havoc with the loss of numerous trees and the death of some squirrel in the Boxing Day storm. The observed impact of change on Grey squirrel life in Kelvingrove hints at the fragility of existence for an animal regarded by some as a friend and by many as a pest.

OBITUARIES

Mabel Scott

Mabel Scott who died on 18th April 1998 was a member of The Glasgow Natural History Society for many years, being a Member of Council from 1949, The Librarian, (along with James Graham) in 1951, The Editor of The Glasgow Naturalist from 1952-4 and Vice President from 1956-8.

She attended Shawlands Academy, where she was an exceptionally talented student, and then studied at Glasgow University, where she graduated Master of Arts and then Bachelor of Science. She joined the staff of Park School where she stayed all her working life, becoming Head of the Science Department. She was a dedicated and hardworking teacher who is remembered with affection by the many pupils who followed careers in science and medicine.

She was fascinated by all aspects of natural history, birds being her main interest and she was for some time secretary of The Scottish Ornithologists Club. When she retired she went to live in Wormit on the Tay estuary which was an excellent place to continue observing birds. She continued to attend the SOC annual autumn conferences, in spite of failing health, until 1993. For many years she came back to Glasgow for meetings of GNHS and the Associaton of Women Graduates. We remember her as a courageous and independent woman, always interested in news of old friends and with a lively curiosity in the natural world. She will be much missed.

Mabel Scott left a legacy to The Society and we record gratitude for this.

Jean M. Millar

Camilla Dickson, botanist

(born December 4th 1932, died May 18th, 1998)

I first met Camilla at a Glasgow Natural History Society meeting in 1971. Jim Dickson had just returned to Glasgow after spending some years at Cambridge University attaining a doctorate in Plant Ecology. Camilla was introduced to his family and friends in his home-town. He resumed his activities with the G.N.H.S. in which he had many friends and Camilla accompanied him to Society meetings and outings. Her quiet charm and friendly nature quickly endeared her to the members and she made many good friends within the Society.

Jim and Camilla met each other when they both worked and studied with Sir Harry Godwin FRS in the sub-department of Quaternary Research of the Botany School at Cambridge University. At that time Sir Harry Godwin was the foremost pioneer of the plant ecology of the glacial and interglacial periods in Britain and Camilla developed a keen interest in archaeobotany. At Cambridge she had developed a critical approach to the identification of pollen grains and macroscopic plant fossils and, as soon as her children, Peter and Kate, were of sufficient age, Camilla resumed her scientific work based in the Botany Department at Glasgow University. She started by concentrating on local aspects of archaeobotany in Scotland, particularly the Bearsden Roman fort. Her observational skill and perseverance proved that the silted-up east annexe ditch had a substantial component of sewage which consisted of the food plants that the troops had eaten and expelled. By meticulous research she identified

At that time I was the departmental photographer in the Botany Department and Camilla would regularly present me with her latest finds to be photographed. She was always willing to spend time explaining the significance of these minuscule plant samples which she knew I found extremely tiresome to photograph. Most were too large for photography using the convenience of a microscope. When my macrophotographs pleased her she was always forthcoming with praise and encouragement - preparing me for the next batch which she was examining! Her energy and enthusiasm for her chosen subject seemed limitless. Her archaeological researches soon expanded to cover most periods of Scottish history at many sites throughout Scotland. The most recent was a survey of the plant remains contained in silt deposits from the mid-fifteenth century drains under Paisley Abbey. All of her discoveries were published in a flow of papers submitted to various scientific journals including the Glasgow Naturalist.

Although Camilla never held office in the Society, her presence was always in evidence. She frequently led summer outings to show members interesting plants in the Glasgow area and in particular, the many species of Orchids which she studied at Dumbrock Loch in Mugdock Country Park. Camilla often had exhibits at the Society's annual Exhibition meetings and in 1990 she delivered the Society's Goodfellow Lecture. The title was a very appropriate one: *Memoirs of a Midden Mavis - The Study of Ancient Diets and Environments from Roman Remains.*

Camilla died after a long struggle against lung cancer a few days after returning from a curtailed botanical and archaeological holiday in Crete with Jim. Only after her illness was diagnosed did she begin to write a book which will be the culmination of her scientific career. The provisional title is *People, Plants and Diet in Ancient Scotland.* She left her book almost complete which will be finished by Jim. Hopefully, the Glasgow Natural History Society, which gave her much pleasure and of which she was a loyal member, will subscribe to the costs of this publication.

Norman Tait

Camilla Dickson 1932 - 1998

BOOK REVIEWS

Compiled by RUTH DOBSON

The Art of Wildlife Photography

FRITZ PÖLKING

Fountain Press, Surrey, 1998, 100pp. hardback with over 100 colour photographs. ISBN 0 86343 322 7 £19.95.

First published in 1995, this book is an English language edition of a German publication. Fritz Pölking, we are told, is an eminent, award-winning Wildlife Photographer from Krefeld, Germany and the book is lavishly illustrated throughout by his stunning and emotive pictures. These pictures are reproduced to a very high standard and are most impressive.

The book is aimed at the enthusiastic photographer who wishes to take up photographing natural history subjects and the inevitable technical information and advice given is presented in four distinct sections; 1 Cameras and Lenses; 2 Accessories (Camera supports, carrying cases, camera releases, filters, bird hides etc.); 3 Exposure Techniques which includes flash and 4 Photographing Nature in which Herr Pölking discusses the aesthetics of photographing wildlife and the intimacy which he tries to capture in his pictures. Each section is illustrated throughout with colourful examples of the results produced by different lens designs and lighting techniques. The text is highly informative but not too technical and will no doubt encourage and inspire his readers to expand their camera equipment and have a try at Wildlife Photography. However, he does not mention the cost of the equipment which he advocates. The author's favourite bird lens is the Nikon 500/f4 lens which alone just happens to cost £5000! Unless the beginner is a lottery winner, they may find they are unable to buy any film!

I was disappointed with the restricted range of species used to illustrate a book on Wildlife Photography. There are 9 pictures of Cheetahs, 6 of Leopards, 5 of White Storks at their nest and 3 of Great-crested Grebes at their nest. Excellent though these are, the book would have benefited by depicting other interesting and colourful wildlife subjects. Apart from one shot of an Alligator, there are no pictures of reptiles or amphibians. There are no pictures of dragonflies or smaller insects taken with the macro lenses about which the author enthuses. The few butterfly pictures included were notified as taken in a butterfly garden! Herr Pölking declares that a tripod camera support is absolutely essential for high quality pictures. This may explain the restricted range of subjects. It is almost impossible to set up a tripod and successfully photograph highly active subjects such as butterflies and dragonflies in the field. Therefore, it seems, he does not photograph them. Obviously Fritz Pölking has a passion for large mammal and bird photography which he does exceedingly well.

Of its kind, this book does not discuss anything that has not already been published in a plethora of similar books written by other Wildlife Photographers. If you are interested in starting Wildlife Photography and do not already have a book on the subject, then this publication gives an excellent introduction and would be well worth buying.

Norman Tait

The Cairngorms of Scotland

STUART RAE & ADAM WATSON

Eagle Crag, Aberdeen, 1998, 144 pp., hardback with 110 large photographs. ISBN 0 95339730 0, £25.

Like Stuart Rae and Adam Watson I feel at home yet have a great respect for these mountains. Stuart Rae took most of the photographs and Adam Watson wrote the words and both give a personal selection of how the authers feel about these mountains. Both men obviously also love and respect them. The Cairngorms seem small in height as compared with the Alps but they have as great a range of biological and geographical type as many parts of the Alps. In a few very carefully chosen words Adam Watson tells a lot about the history and the natural history of the area.

I have seen these mountains on a gentle summer day and some photographs, showing them in their true beauty on a still day, in normal winter conditions, and the Subarctic desert of the 4,000 ft plateau of Breariach, make me want to be there. Although we know that pines at one time in history did reach higher up the mountains, as names like Glen Geusachan (*glen of little fir wood*) suggest, and remnants of stumps confirm, there is a timeless beauty about this landscape. We feel and know that most of the high tops, of which there are a number of superb photographs, have probably looked as they do now since just after the retreating ice of the last Ice Age.

A walk that I often make from the high tops to the Ryvoan Pass is like walking through 10,000 years in time, and in few areas of Scotland, we see this range of geographical and biological type. I also am familiar with the Cairngorms on the kind of day when the mountain rescue team is called out - often in weather that they would never have chosen to go out in - and it is then that you appreciate the true wildness of this subarctic part of Scotland, while in the Pass of Ryvoan we find the wonderful mix of trees, shrubs and flowers which may have covered much of the lower ground in the past.

Their plant, bird and animal photography show the secret nature of the wildlife in this area. The wigeon sitting quietly on its nest under the heather on page 78, the delightful red deer calf camouflaged among tall heather on page 79, and the Ptarmigan on nest, beautifully camouflaged among alpine heath as she incubates her eggs, are very fine examples of this. The colours as illustrated in the photographs of blaeberries and lichens are truly evocative of the muted yet rich colours of the sub summits.

I loved this book and would be delighted to own a copy of it to look at whenever I am not able to go to the Cairngorms.

Agnes Walker

Collins Wild Guides
Wild Animals of Britain and Europe

JOHN A. BURTON

Harper Collins, London, 1998, 227 pp., softback with coloured photographs of each species, distribution maps, select bibliography, glossary. ISBN 0 00 22 000 82, £6.99.

This is an easily read beginners guide with a useful glossary of technical terms. The photographs are of good quality. A useful 'ID' fact file for each species notes species that can be confused with each other. There are also useful distribution maps although these are rather small in size making study in poor light difficult. This book attempted to cover too wide a field of natural history and it would have been better had separate guides been devoted to, for example, reptiles and amphibians. As well as being suitable for the adult beginner this book would not be out of place on the shelves of a children's library. Its format is ideal for use in the field and it is reasonably priced.

Margaret M. H. Lyth

Collins Watch Guides: Adventures in the Natural World

Birds in Winter
MARC DUQUET
ISBN 0 00 220100 3
Mushrooms and Toadstools
BERNARD DUHEM
ISBN 0 00 220102 X
Night Sky
PHILLIPE HENAREJOS
ISBN 0 00 220103 8
Trees of the Countryside
ELISABETH TROTIGNON
ISBN 0 00 220101 1

Harper Collins, London, 1997, 48pp., softback, ring bound with colour illustrations and linedrawings. £5.99 each.

These compact introductory books were all written originally in French and translated very clearly into English by Jo Weightman. Whilst being written for a French audience is not important as far as the astronomy book is concerned, since Britain shares similar longitudes with France, this is a problem to some extent in connection with the other three titles, where species are encountered that are not normally found in this country. This is not helpful to a beginner.

The bird book purports to be a guide to birds in winter but contains a section that deals with summer plumage. Although many references are made to birds found overwintering in Britain, there is a chapter dealing with birds of the Mediterranean. Similarly the black and white section of the book, whilst it includes five birdwatching sites in Britain, maps eighteen sites on the continent. This section does, however, deal with bird identification, feeding birds and making nest boxes in a simple practical way.

Unusually for texts about fungi, this one looks at the fungi of different habitats rather than in systematic order, although the characteristics of the main groups of fungi are dealt with. This approach is helpful to the beginner. Some of the habitats are not found in Britain, but many are, and the quality of the colour illustrations compares favourably with many other texts about fungi. A useful feature of the illustrations is that lines are used to indicate the spot characters of individual fungi. The black and white section deals with the classification, physiology, growth and reproduction of fungi with final sections about collection, problems of identification and cooking.

The astronomy book is surprisingly colourful and deals with astronomical phenomena on earth, such as eclipses, meteors and zodiacal light. This is followed by chapters about the moon, sun, solar system, individual planets, galaxies and nebulae. The black and white section gives details of telescopes, both amateur and professional, and deals briefly with the history and future of the universe. Strangely for a book aimed at the beginner, diagrams of the main constellations are lacking.

The tree book contains many references to trees and habitats found in Mediterranean countries but not in Britain. So this book would be useful to English speaking travellers on the Continent. One drawing of London plane trees depicts a group of locals playing 'boules' in the village square. Most of the book deals with tree identification, making use of high quality bark photographs and good quality colour illustrations of leaves, flowers, seeds and fruits. The black and white section deals with tree physiology and the evolution of trees. The treatment is necessarily brief and superficial in the space available, but interesting nonetheless.

At £5.99 each the above books provide much basic, easily carried information for the beginner in good quality binding and waterproof pages. A further 10 titles are planned to appear in this series.

Bob Gray

Plant Crib 1998

T.C.G. RICH & A.C. JERMY

Botanical Society of the British Isles, London, 1998, vii + 391 pp., softback with numerous line drawings. ISBN 0 901158 28 3, £20.50.

It is now over a decade since the first *Plant Crib* was published by the BSBI in 1988, and since then much new information has come to hand concerning the identification of members of the British flora, much of which it has not proved possible, due to constraints of space, to include in the latest standard floras (e.g. Stace, 1991). In this updated version the opportunity has been taken to include many more drawings to support the text which is arranged under the respective genera and species in botanical order. Ferns are included, as are a number of introduced plant species.

The publication of this Plant Crib has been timed to coincide with the period of field work for the preparation of a new distribution Atlas of British plants due for publication by the BSBI in a few years time (Atlas 2000). Workers for this project will therefore have available the most up-to-date information on identification gleaned from the literature or from original contributions.

The printing of both text and illustrations is of excellent quality. However, the size and weight of the book, A4 and a hefty 1kg, probably indicates an item for the car rather than the rucksack.

Allan Stirling

The Colour Identification Guide to Caterpillars of the British Isles

JIM PORTER

Viking, London, 1997, 275 pp., hardback with many colour photographs. ISBN 0 670 87509 0, £40.00.

This handsome volume has been produced to complement Bernard Skinner's *Colour Identification Guide to Moths of the British Isles* (Viking, 1988). After a brief introduction to collecting and handling caterpillars and a glossary and list of abbreviations, concise descriptions of some 850 species are given together with notes on their food-plants, distribution and habits within the British Isles. Colour photographs of all but 42 species on their food plants, follow and the book concludes with a list of protected species, a short bibliography, addresses of entomological societies and equipment dealers, the common and scientific names of food-plants and indices to the scientific and English names of the species included.

The format and layout closely resembles that of Skinner's volume but there are differences. All macrolepidoptera (i.e. including butterflies) are considered; about 24 species (based on very few records) have been omitted and about 8 recently recorded forms have been added. Subspecies are not recognised so that Oak Eggar and Northern Eggar are not distinguished.

This is a well-produced and important book - I wish it had been available earlier in my career.

Ronald M. Dobson

A Checklist of Irish Aquatic Insects

P. ASHE, J.P. O'CONNOR & D.A. MURRAY

Occasional Publication of the Irish Biogeographical Society, Number 3, Dublin, 1998, 80 pp., softback. ISBN 0 9511514 2 8. £6.00 (Sterling or Irish including p.&p., copies obtainable from Dr. D.A. Murray, Dept. of Zoology, University College, Belfield, Dublin 4, Ireland).

As the title implies the main text of this publication is a checklist, pure and simple. Only the latest names are included so that, without synonyms, anybody working with old records or specimens would still need to refer to more comprehensive lists, such as those of Kloet and Hincks, to appreciate their material. With this reservation the present volume lists an impressive 1499 species from the whole of the island, i.e. about 73% of those found in the British Isles as a whole. Of these 26, species are exclusively Irish.

Orders included are Collembola, Ephemeroptera, Odonata, Plecoptera, Hemiptera, Coleoptera, Neuroptera, Megaloptera, Hymenoptera, Trichoptera, Lepidoptera and Diptera. In general, literary references follow the lists for the separate orders but for the Diptera, by far the largest group, introductory comments precede and references follow those for each family.

Ronald M. Dobson

Provisional atlas of the aculeate Hymenoptera of Britain and Ireland Part 2

ROBIN EDWARDS (Ed.)

Bees, Wasps and Ants Recording Society, Huntingdon, Biological Records Centre, 1998. 138 pp., softback with distribution maps for each species. ISBN 1 870393 42 2, £6.00. Copies available from Publication Sales, Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria, LA11 6JU.

Part 1 of this atlas was reviewed in Glasgow Naturalist 23(3), 74(1998) and in the introduction to this second part a note is provided of the method by which the selection of species for such treatment was made. The criteria include a balance between common and rare species or those which could be put into matching pairs of sibling species, or host with kleptoparasite. In addition, the currently pressing matter of having Biodiversity Action Plans and the availability of biological data has influenced the choice. What can feasibly be achieved is also a factor, given that most of those involved do so voluntarily and rely on a network of amateur naturalists for much information. Thus the mix of species is explained and is a satisfactory taster to the wide range of interesting life cycles exhibited by the aculeates. As with the first part, this selection could engender sufficient curiosity in those who may be unacquainted with the bees, ants or wasps so that they may feel inclined to go out into the field and look for similar things in their own back yard. Let's hope so - there is so much to learn about natural history at all levels of study and Scotland provides plenty of space for doing it in.

E.G. Hancock

Provisional atlas of the ground beetles (Coleoptera, Carabidae) of Britain

MARTIN L. LUFF

Biological Records Centre, Huntingdon, 1998, 194 pp., soft back with distribution maps for each species. ISBN 1 870393 41 4, £7.50. Copies available from Publication Sales, Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU.

Maps are given for the 349 species (without just one which was only found to occur in Britain after compilation had begun) and each is accompanied by a short paragraph which is an extremely useful summary of the known biological information. Red Data Book and other cross-references relevant to status are also given. The introductory text usefully updates the latest checklist and includes other data on species which is otherwise scattered in a variety of sometimes obscure journals and newsletters. This is a useful inclusion as latin names of insects have a nasty habit of appearing and disappearing from the literature. This is most confusing to one who is not expert in a particular family. Seven pages of recent literature references and an index complete this atlas. Recent productions in this series are beginning to resemble mini-handbooks, more than just pages of maps. Thus they deserve to occupy shelf space next to the identification guides and text books and are of utility to both beginner and the more experienced naturalist.

E.G. Hancock

Last instar larvae and pupae of the Simuliidae of Britain and Ireland, a key with brief ecological notes

JON BASS

Freshwater Biological Association, Scientific Publication No 55, Ambleside, 1998, 102 pp., softback with line drawings. ISBN 0 900386 58 4; ISSN 0367-1887, £14.00.

The FBA Guides are designed for use by aquatic biologists or the more involved naturalists who require to identify their target organisms in what may appear initially to be obscure groups. This is of course beneficial to the serious student who needs access to such a breadth of knowledge but the Simuliidae are hardly obscure. Better known as black flies, they are important as vectors of diseases to humans and their stock animals, especially in tropical areas, as well as wild birds and mammals. Everything required to work with the British fauna of this group is provided within the covers of this booklet - updated checklist, anatomical diagrams and summaries of biological data for each species. Methods of collection, preservation and preparation precede the well-illustrated keys. It seems to be the case, at least in the reviewer's experience, that very few people suffer from blackfly bites in Scotland but these insects rose to prominence a few years ago when a village in Dorset gave its name to one species, *Simulium posticum*, which became known as the Blandford Fly. (In North America they are referred to as punkies which seems to have a suitably aggressive tone). Their involvement in spreading diseases means that simuliids are of direct importance to people and the juvenile stages also form a significant element of the aquatic food chain. So this new key is a tool to be welcomed as another valuable contribution from the Freshwater Biological Association.

E.G. Hancock

Ticks: A Lay Guide to a Human Hazard

GEORGE HENDRY AND DARREL HO-YEN

The Mercat Cross, Edinburgh, 1998, 96 pp., softback with seven illustrations. ISBN 1 873644 80 9, £4.99.

This easily read, pocketable handbook gives "precise information on ticks and tick-borne diseases and how to avoid them". Written for all who enjoy &/or work in the countryside, it concentrates on our common *Ixodes ricinus* and Lyme disease but also gives a handy and concise, up to date summary of other ticks in the world and the main infections they carry. Risks are indicated without alarmist exaggeration. Recommendations for avoiding or removing ticks are given clearly. Brief historical and ecological background narrative adds to the interest and this inexpensive book merits wide readership.

Norman R. Grist

The Breeding Birds of South-East Scotland: A Tetrad Atlas 1988-1994

RAY MURRAY, MARK HOLLING, HARRY DOTT & PETER VANDOME

The Scottish Ornithologists' Club, 1998, Se Sc Publication Group, c/o J G Mattocks, 9 East Fettes Avenue, Edinburgh EH4 1DN, 357 pp., hardback with 20 maps, 28 aerial views, 9 graphs, drawings of the species described and 31 appendices. £27 + £3.40 p&p.

This well-produced survey on A4 pages is a worthy achievement of superb voluntary teamwork by the ornithologists of SE Scotland. Based on 2km squares, it records the distribution and numbers of breeding birds in 25 times greater detail than earlier published national Scottish surveys which were based on 10 km squares. It describes the terrain, the methods used, the data obtained and its analysis in critical detail useful for others planning such surveys.

The status of each breeding species is given, with population estimates, compared with earlier reports, and related to habitat and other factors. The main characteristics of each species are summarised and followed by a critical account of the evidence and its collection, the population distribution compared with past records, current influences and estimated trends, and what proportion of the total recorded British population the observations represent.

This pioneer achievement is well written and creditably readable containing much of interest additional to the survey itself. It is an important landmark and key reference work which is to be followed by other Regional surveys by Scottish Ornithology Club members and their helpers.

Norman Grist

Birds Of Southern South America and Antarctica

MARTIN R. DE LA PENA & MAURICE RUMBOLL

Harper Collins, London, 1998, 304 pp., softback with coloured illustrations. ISBN 0 00 2200775 5, £19.99.

This is an English adaptation of a classic Spanish guide to the birds of the Argentine extended to include the birds of Chile, Bolivia, Paraguay, southern Brazil and Uruguay. It is remarkable that the task was accomplished when you consider the problems involved in combining information from different countries with different languages and a variety of common names. I had a problem recently checking out a Chiloe wigeon which appeared on the local Barons Haugh bird reserve. As tends to be the problem when using common names, the bird, *Anas sibilatrix*, is listed as the southern wigeon. The book contains more than 1000 species illustrated in colour and there are distribution maps which are not in colour. If you wish to buy a single bird guide to all the countries listed above this is probably a good buy although the information is somewhat basic. Although I do not envisage travelling to South America to birdwatch, this is a handy book to have for reference, when you consider the increasing numbers of so called foreign birds appearing in natural habitats and setting up breeding colonies.

Ian C. McCallum

Bird Nests, Eggs & Nestlings of Britain and Europe

COLIN HARRISON & PETER CASTELL

Harper Collins, London, 1998, 462 pp., hardback with numerous colour plates and black and white drawings. ISBN 0 00 220125 9, £17.99.

This is one of the excellent Collins field guides. It was originally published in 1975 and has been reprinted on several occasions, each reprint updating the entries to accord with the latest information available.

Some people may regard the study of eggs and nests as a hangover from the Victorian era, but the book specifies that it is for bird lovers and not egg collectors. Any conservation worker must be able to identify birds in his area whether it be from the nest, eggs, or nestlings, and this is the guide that will enable him to do that.

It is assumed that the reader has a copy of the guide by Heinzel, Fitter & Parslow to the 'Birds of Britain and Europe, including Africa and the Middle East'. As both guides cover the same area it would mean that details of bird species, including distribution maps etc given in Heinzel's book together with the Harrison book would give the reader a thorough overall appreciation of the bird species. This enables Harrison's publication to concentrate in detail on the nests, eggs, and nestlings. 611 species are covered by virtue of coloured egg and nestling plates: black and white drawings of nests and other salient details. A descriptive text covers the following:- Nest, Breeding season, Eggs, Incubation, and Nestling. There is also an interesting identification key. In conclusion, read with a good bird field guide, this is a good buy at £17.99.

Ian C. McCallum

Bird Call Identification (A CD and book on how to identify birds from their song)

GEOFF SAMPLE

Harper Collins, London 1998, 62 pp., hardback. Many wave form diagrams and sonograms. ISBN 0 00 220122 4, £14.99.

An excellent little guide and Compact Disk with many calls and a narrative to accompany them. The text includes and explains sonograms, the pictorial representation of bird-calls, and then by playing the disc examples can be heard and related to the image. The author has wisely tried to give a series of examples of closely allied calls which can confuse the beginner. These are not always taxonomically closely related species but simply sound very similar. Perhaps calls such as Cuckoo and Collared Dove might have been included but 130 species are covered and the CD lasts 73 minutes, so there is a lot to get through. The sound quality is technically superb and I can thoroughly recommend this new form of sound guide to all who have an interest in recognising birds without necessarily seeing them.

Bernard Zonfrillo

The Birds of Sutherland
ALAN VITTERY (Illustrations by DAVE PULLAN)

Colin Baxter Photography, Grantown on Spey, 1997, 160 pp., softback with maps, diagrams and ten drawings. ISBN 1 900455 18 8, £9.95.

This is a compact, very readable and up to date survey of birds found in Sutherland. It lists 310 species including rarities. Concise accounts of relevant geography, habitats, changes in use of land and sea, breeding specialties, migration and weather influences, and 'where to find' advice are followed by concise and interesting accounts of each species, trends and historical records where relevant. After 31 listed references comes a list of significant ornithological events from 1836 to October 1996, and appreciation of Donnie MacDonald of Dornoch whose over-60 years' observations and writings in the forties contributed so much, and a list of useful addresses. This attractive booklet is a handy 'must' for Sutherland birders and will tempt many others to explore this haunt of some of our rarest breeding birds.

Norman R. Grist

Attracting Birds to Your Garden

STEPHEN MOSS & DAVID COTTRIDGE

New Holland Publishers (U.K.) Ltd., 1998, 157 pp., hardback with 250 colour plates. ISBN 1 85368 569 0, £16.99.

This is an attractive, well laid-out book with high quality photographic illustrations. The various chapters provide a wealth of information on every aspect of their topics and should provide an interesting and enjoyable read even for bird enthusiasts without gardens. For those with postage stamp sized gardens the chapter entitled, "Planning the Garden", may seem daunting but suggestions on minor changes of layout and plant selection are more than useful.

Eighty species of bird are described in the Directory, the last section of the book, not all of which one would expect to see in a northern garden. However, each species is very well described with a paragraph on identification and a section on each bird's relevance to the garden. All are illustrated with two good photographs.

There is a chapter on providing water in the garden, be it bird bath or pond, and also one on providing suitable nest sites and nesting boxes. A further chapter deals with hazards faced by garden birds from natural predators and those created by humans.

If the advice given in the chapter on feeding birds is followed one's garden could become a veritable "Hilton" for birds. Altogether this book is more than just about attracting birds to the garden. Following the advice given should also ensure a haven for other forms of wild life.

Joyce Alexander

Garden BirdWatch Handbook

ANDREW CANNON

British Trust for Ornithology, Thetford, Norfolk, 1998, 80 pp., softback with numerous colour illustrations. ISBN 0 903793 98 9, £2.00.
(Available from British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU, Tel. 01842 750050)

The aim of this attractive book is to inform can encourage BTO volunteers, who, by taking part in the Garden BirdWatch Project, and enable the BTO to monitor the changes in bird populations over a long period. This knowledge can then be used for conservation purposes.

It contains detailed information on the behaviour of 41 bird species which frequent gardens and includes an introduction about habitats and bird foods, emphasising the planning of gardens for birds now that wild habitats are declining. There is also some information on how the data are processed, a glossary and bibliography.

It is excellent value and of interest to anyone with a garden, and with its help anyone can take part in the project.

Ruth H. Dobson

How to Find and Identify Mammals

GILLIE SARGENT & PAT MORRIS

Mammal Society, 1997, 79 pp., softback with black and white sketches and drawings. ISBN 0 906282 28 4, £8.95. (Available from The Mammal Society, 15 Cloisters House, 8 Battersea Park Road, London, SW8 4BG)

Although a publication by the learned Mammal Society, this user friendly guide will be found to be the answer to all those people who wish to identify the animal responsible for the dropping on the footpath, the hole in the ground, or the half chewed hazelnut.

The main function of the guide is to enable mammal surveys to be carried out effectively by giving the surveyor concise text and clear sketches to simplify mammal identification. These surveys should indicate what conservation measures should be implemented to safeguard threatened species.

The booklet comprises the following parts:- Planning mammal surveys, Making sightings, Identifying mammal calls, Looking for signs, Recording dead mammals and parts of mammals, and Live trapping. The appendices contain various proformas for recording mammals, using different recording methods, together with details of more specialised booklets in the Society's Occasional Publications Series.

There are many interesting facts, such as that there are over 100, 000, 000 bottles a year lost from circulation, and that a discarded milk bottle from Essex was found to contain the remains of 28 small mammals. A monitoring system which I had not encountered previously was the use of hair tubes, which have double-sided tape attached to the inside of the tubes to collect hairs from small mammals. The hairs can then be identified to indicate the mammal species.

Although this publication cannot compare with the Mammal Society's Handbook of British Mammals, it is an excellent publication, which is particularly useful in the field, and well worth £8.95.

Ian C. McCallum

Dolphins

BEN WILSON

Colin Baxter Photography, Granton-on Spey, Scotland, 1998, 132 pp., hardback with numerous colour plates. ISBN 1 900455 54 4, £20.

This handsome, large format book lives up to the claim on its cover that it provides an introduction to the beauty and mystery of this diverse group of over 30 species of aquatic mammals. In clear, non-technical language it discusses the origins, form and function and life-cycles of the various dolphin species and then deals with the special characteristics of oceanic, coastal and river species separately.

Methods and problems of dolphin research and conservation are discussed at length and there are short chapters on dolphin strandings, getting to know dolphins and how to make useful observations on them.

The book starts with a double-page spread of excellent scale paintings of 30 species and ends with a short bibliography, a tabular classification of toothed Cetacea in general, a tabular summary of some facts concerning dolphins and an index.

The 69 colour photographs, from numerous acknowledged sources but, regrettably, often without captions, vary from good to magnificent but why, in a British book, are American spelling conventions used?

Ronald M. Dobson

Whales and Dolphins. the Ultimate Guide to Marine Mammals

MARK CARWARDINE, ERICH` HOYT, R. EWAN FORDYCE & PETER GILL

Harper Collins, London, 1998, 288 pp., hardback with numerous colour photographs and drawings. ISBN 0 00 220105 4, £17.99.

This is another in Harper Collins' series of 'Ultimate Guides' which are all characterised by their superb illustrations and easily digestible format of chapters divided into short, at most two-page, articles. Given the subject matter of this volume, it is not surprising that many of its colour photographs are outstanding, and there is also an ample sprinkling of other illustrative material including well-designed diagrams and examples of cetacean iconography.

The first six chapters dip into every aspect of the biology of whales, dolphins and porpoises and of mankind's dealings (benign and malign) with these animals. From the mysteries of sound communication and echolocation, to the achievements of the International Whaling Commission, to handy hints on dealing with beached whales, no cetacean stone is left unturned. This has its down-side. No doubt the organisation of information into snack-sized chunks makes this and its companion volumes suitable for short attention spans, but it leads inevitably to some topics, such as cetacean evolution, being treated very superficially. Also some of the articles are frankly redundant: that entitled 'Unique features' consists entirely of information repeated in the field guide to individual species.

The seventh chapter is a field guide that describes 57 of the 81 currently recognised species of cetaceans. Each species is well illustrated, its biology is described concisely, and vital information is summarised in highlighted 'Field notes' panels. This and the final chapter, which gives information on 30 whale-watching areas across the globe, are the best parts of the book

I have two final complaints. Firstly, the subtitle is completely erroneous: no guide to sea-mammals can be 'Ultimate' when it deals with neither the pinnipedes (seals, sea-lions and walrus) nor the sirenians (sea-cows). Secondly, since some of the chapters have uninformative titles like 'Understanding Whales, Dolphins and Porpoises', the topics covered in each should have been listed on the 'Contents' page or at the start of each chapter. This deficiency is common to all the books in the series.

Despite its flaws, this book very effectively gets across the message that the cetaceans are amongst the most awe-inspiring products of biological evolution. I can recommend it to any non-specialist who wants to learn more about these animals.

Iain C. Wilkie

Bats: biology and behaviour

JOHN D. ARMSTRONG

Oxford University Press, Oxford 1996 (paperback 1998), 262 pp., paperback with numerous line drawings, graphs and diagrams. ISBN 0 19 850332 9, £17.99.

This is an excellent review of bat biology, clearly written and covering the recent literature well. It is aimed at undergraduates, but is written in a lively style that would interest anyone with a serious interest in the natural history of these remarkable animals. Bats form a quarter of all mammal species. Until recently we knew very little about these animals, but in recent years there has been a great increase in research work on bats and an accessible text for the general reader on this recent work is very welcome. The book starts with a good review of the current lively taxonomic debate over whether the fruit bats are not, as usually assumed, closely related to the insectivorous bats, but are descended independently from the same ancestors as the primates. The evidence for both sides of this discussion is complicated, but very well reviewed. There is then a description of the various groups of modern bats. A chapter on flight provides an accessible account of recent studies, as does a review of work on echolocation and the physiology of their hibernation. There is a brief chapter on breeding, which shows that bats have remarkably fast growth rates for a mammal, and a longer section on feeding ecology. The book then ends with short sections on how bats fit into wildlife communities, their predators, the interactions between fruit bats and the plants on which they feed, and their conservation. The book is an excellent introduction to recent bat studies, and leaves the reader wanting to learn more about a group of very remarkable animals. Highly recommended.

David C. Houston

Erratum

In *Glasgow Naturalist* 23 (3), 1998, P69, the final lines of N.R. Grist's review of '*The Wildfowl & Wetlands Trust*' were deleted. These should have read 'cartoons and diagrams. There is much of interest and value for readers involved in the practicalities of such works, both physically and in raising public awareness of the value of conservation of wildfowl and wetland habitats throughout the world'. His first name should also have read Norman, not Normal.

PROCEEDINGS 1998

The Chairman, place*, number present, lecturer's name and title of lecture are given for most meetings.
*BOB Boyd Orr Building
HL Hillhead Library
GKB Graham Kerr Building

14th January
Norman Tait, BOB, 66, 29th Paisley International Colour Slide Exhibition, Natural History Section, Compiled by members of Paisley Colour Photographic Club and presented by W Brown.

10th February
Norman Tait, BOB, 53, "Scottish Wild Cats" lecture by Dr Andrew Kitchener of the Royal Museum of Scotland.

24th February
Norman Tait, BOB, 44, 68th AGM. Reports were presented on activities during 1997, and elections held, resulting in appointments as shown opposite. Membership stands at 249 made up of 205 ordinary, 26 family, 1 junior, 6 school and 11 honorary members. There were 3 Council Meetings and the executive met informally as required.
The AGM was followed by an illustrated talk on "Wildlife in your Home" by Liz Parsons of Starling Learning.

10th March
Norman Tait, BOB, 46, "Survey of the Botanics". Introduced by Geoff Hancock, the Botany was described by Dr Peter Macpherson, the Birds by Prof. Norman Grist and Geoff Hancock rounded the evening with a description of the other animals to be found in the Botanic Gardens.

14th April
Norman Tait, BOB, 40, Lynne Farrell, "Shetland - its Natural History".

22nd May
Norman Tait, BOB, 44, Azra and Peter Meadows, "Life in the Sea - Potential Effects of Global Warming".

A summer programme of 17 outings were arranged and although two at least had to be cancelled and several were not well attended due to the weather, those that participated enjoyed the various events.

2nd October
Norman Tait, GKB, 53, welcomed members to the Exhibition Meeting with Wine and Cheese.

13th October
Norman Tait, BOB, 50, Blodwen Lloyd Binns Lecture Prof. John Proctor - "Tropical Rainforest".

7th November
Norman Tait, GKB, 73, Jt. Meeting with BSBI Michael Braithwaite - "The Botanist in Berwickshire".

10th November
Norman Tait, HL, Jt with Friends of the Botanic Gardens Speaker - John Bond - "Keeper of Kew Gardens".

24th November
Norman Tait, BLB, 50, Members Slide Night 10 Members presented varied slide shows.

8th December
Norman Tait, Glasgow University College Club 37 attended an excellent Christmas Dinner and thoroughly enjoyed Stephen Barabas giving a presentation of "A Vets Life in Toronto Zoo".

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SESSION LXVIII 1998

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Society Events

Summer Excursions

From a glass Lantern Slide, Kelvingrove Museum

Picture restoration by T. Norman Tait

Members of the Andersonian Naturalists' Society pose for the camera on an outing to the Falls of Clyde in 1889.

On the 2nd of July 1851, nine 'Gentlemen interested in Natural Science' met in Glasgow and formed a Society which they called the Natural History Society of Glasgow. This Society flourished and, over many decades, assimilated into it a number of other Natural Science organisations based in Glasgow including the Andersonian Naturalist's Society in 1931. After a number of name changes the Society finally emerged as the Glasgow Natural History Society in 1979. Since 1851 the Society has organised a full programme of Summer Excursions which have always proved popular with the membership. These outings give members an opportunity to meet each other informally and learn from experts in various aspects of Natural History.

The Summer Excursion Programme for 1999 is now in progress and all members and their friends will be made welcome.

The Glasgow Naturalist

Advice to Contributors

1. The Glasgow Naturalist publishes articles, short notes and book reviews. Book reviews are commissioned by the Librarian, and all books reviewed are kept in the Society's Library. Articles and short notes should be sent to The Editor, Glasgow Naturalist, c/o Natural History Department, Museum and Art Gallery, Kelvingrove, Glasgow G3 8AG. Short notes are edited by Mr A. McG. Stirling. Articles are refereed by the Editorial Board. Final acceptance of articles and short notes is the responsibility of the Editor. The journal is usually issued in May each year. The subject matter of articles and short notes should concern the Natural History of Scotland in all its aspects, including historical treatments of natural historians.

2. Short notes should not normally exceed one page of A4 single-spaced. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references.

Short notes may cover, for example, new stations for a species, rediscoveries of old records, additions to records in the Atlas of the British Flora, unusual dates of flowering, unusual colour forms, ringed birds recovered, weather notes, occurrences known to be rare, interesting localities not usually visited by naturalists, and preliminary observations designed to stiumlate more general interest.

3. Articles should be more substantial than short notes, and have no upper limit of length. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. The text should normally be divided into sections with sub-headings such as Introduction, Methods, Acknowledgements, etc.

4. References should be given in full (please do not abbreviate journal titles) according to the following style:

Pennie, I.D. (1951). Distribution of Capercaillie in Scotland. *Scottish Naturalist* 63, 4-17.

Wheeler, A. (1975). *Fishes of the World.* Ferndale Editions, London.

Grist N.R. & Bell, E.J. (1996). Enteroviruses. Pp. 381-90 in Weatherall, D.J. (editor) *Oxford Textbook of Medicine.* Oxford University Press, Oxford.

5. The nomenclature of vascular plants should be as in Stace, C.A. (1991). *The new Flora of the British Isles.* Oxford University Press, Oxford. Normal rules of zoological nomenclature apply.

6. Submitted manuscripts (two copies) should be typed double-spaced on A4 paper. Once a manuscript has been accepted, typesetting is greatly assisted if the manuscript can be supplied on a microcomputer diskette. Authors are therefore strongly encouraged to produce manuscripts using a wordprocessor (preferably on a PC-compatible microcomputer). However, to assist amateur naturalists, the Editor can make arrangements to have hand-written manuscripts typed.

7. Tables are numbered in arabic numerals e.g. Table 1: they should be double-spaced on separate sheets with a title and short explanatory paragraph underneath.

8. Line drawings and photographs are numbered in sequence in arabic numerals e.g. Fig. 1. If an illustration has more than one part, each should be identified as 9a), (b) etc. The orientation of the figure and name of the first author should be indicated on the back. They should be supplied camera-ready for uniform reduction of one-half on A4 size paper. Line drawings should be drawn and fully labelled in Indian ink, dry-print lettering or laser printed. A metric scale must be inserted in micrographs etc. Legends for illustrations should be typed on a separate sheet. The Editor is able to accept a small number of high quality colour photographs for each issue.

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11. All submissions are liable to assessment by the Editor for ethical considerations, and publication may be refused on the recommendation of the Publications Committee.

Acknowledgements

The Editor wishes to thank Irene McLaren, Andrea Aitken and Daska Birmingham for typing, Norman Tait for preparing the photographs, and Universities Design and Print for their expert printing work.

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Back cover : Copepod parasites of polychaete worms in Scottish waters. See Paper by O'Reilly, ps 46-7.
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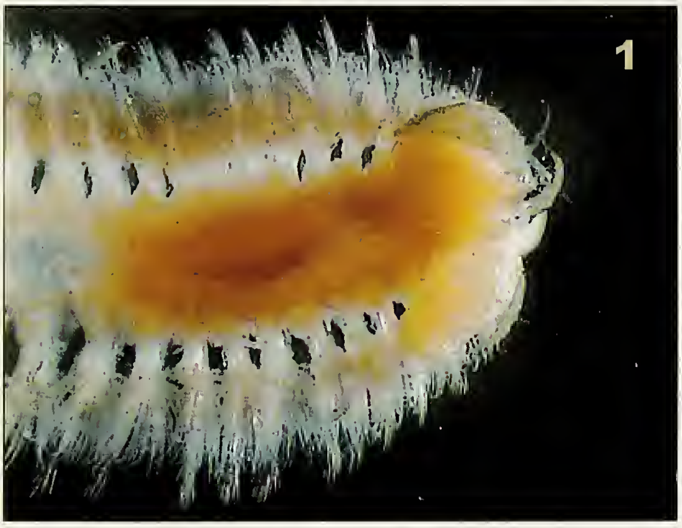
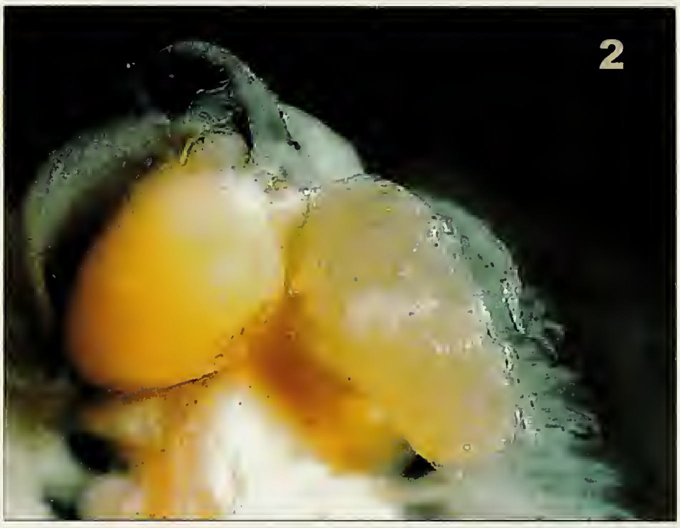
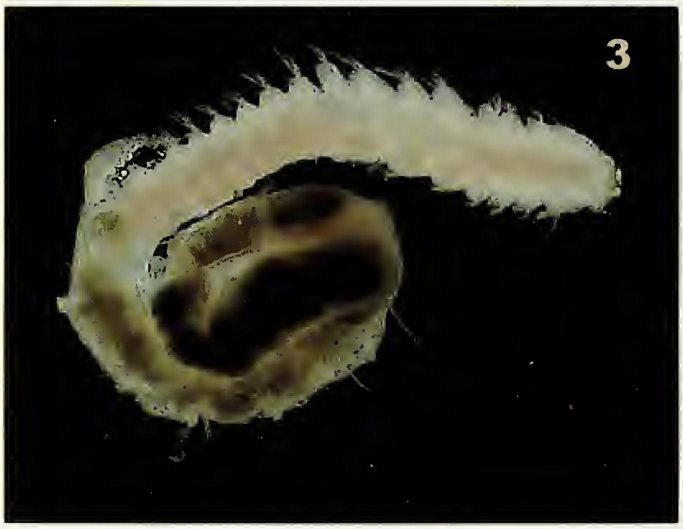


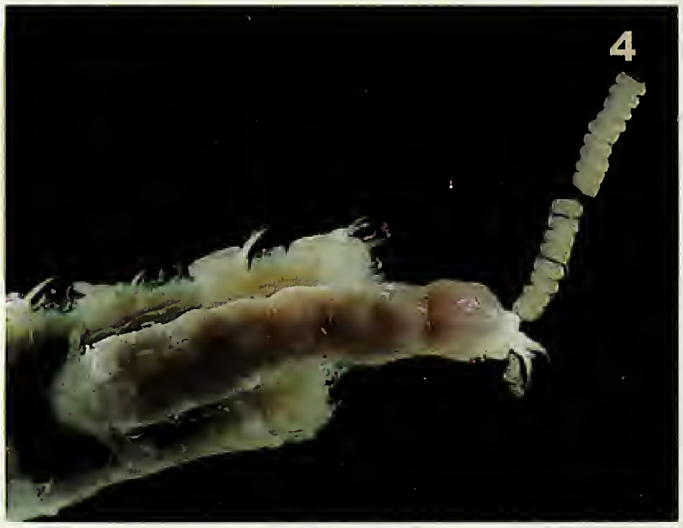
Herpyllobius polynoes - female with single ovisac



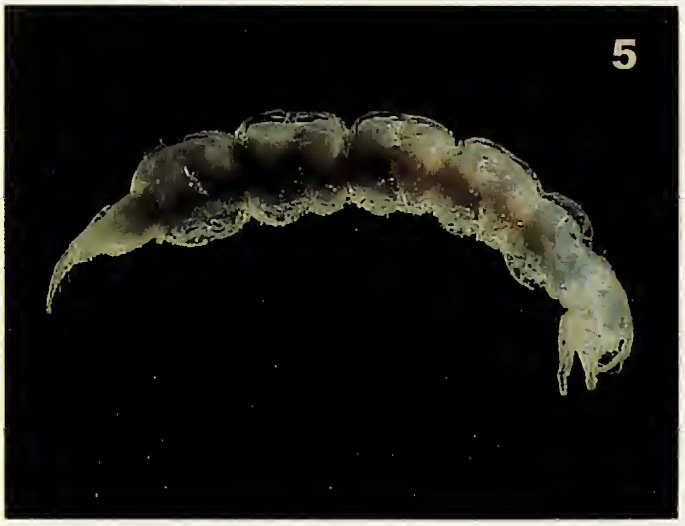
Herpyllobius polynoes - close up of female



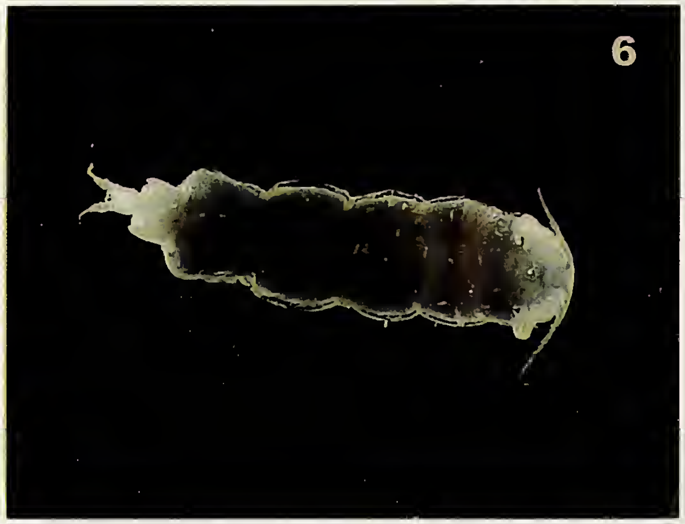
Spiophanicola spinosus copepodite



Spiophanicola spinosus - dorsal view of female



Spiophanicola spinosus - mature female, lateral view



Spiophanicola spinosus - mature female, ventral view

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The Glasgow Naturalist

Volume 23

Part 5 2000

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

GLASGOW NATURAL HISTORY SOCIETY
(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow, the Glasgow Art Gallery and Museum, or Hillhead Library.

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The Glasgow Naturalist

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EDITORIAL Alien species: our 'stewardship' role

The sub-committee charged with organising a conference to mark the 150th anniversary of the Glasgow Natural History Society's establishment quickly came up with the theme of 'Aliens'. The conference will be in June 2001 and will happily fit into the celebrations of the founding of an even more venerable institution, the University of Glasgow, 550 years ago. This short essay is intended as an aperitif for the conference: I hope it will stimulate and prepare members for what should be a lively and thought provoking meeting.

'Alien', from the Latin *alius* = other. Of a plant or animal species – introduced from elsewhere and naturalised. More generally – unfamiliar, unfriendly, hostile, foreign; from other worlds, extra-terrestrial. When we use the world 'alien' to describe introduced species, it is hard not to think also in these more general terms: hostile, foreign species which ought not to be here, which do 'our' species harm.

But consider a different term: 'exotic' = introduced from or originating in a foreign, especially tropical, land; unusual, bizarre. We are rather excited by the exotic, which implies mystery and an exuberant diversity beyond our normal, more sober, reality. Or 'invader', even worse than 'alien', perhaps. Invaders are clearly out to take over and destroy, like those nasty Vikings from our history books who burned, raped and pillaged to their hearts' content...

All of these words and more are used to describe species in habitats beyond their 'normal' ranges, and our attitudes to them are variously affected by the connotations of these terms. Let's try here to go further and think about alien species in ecological and evolutionary ways.

On a geological time scale, land masses slowly change location on the Earth's surface, collide, sink, erode, rise up. There is no constancy of habitat and therefore no constancy of species when we are thinking in millions of years. Even on the shorter, more recent time-scale of the Quaternary period, from 1.5 million years ago to the present, Scotland (as one example) has been subjected to the huge landscape changes resulting from successive glaciations. Alternately linked to and separated from continental Europe, the country had only a short time to develop a new, post-glacial range of species and habitats before being affected by another disruptive factor, the invasion of *Homo sapiens*. Human technological abilities allowed other species to cross what might otherwise have been insurmountable dispersive barriers. Mostly, we spread species on purpose: food plants, garden plants, animals for food and fur; but many also spread by accident – rats and cats on ships hopped from island to island; insect and other pests arrived in the soil covering the roots of introduced plants; marine invertebrates crossed the oceans in ships' ballast water. Some invasions were more than we bargained for: with invading species came hanger's on – ectoparasites, micro-organisms, often bearers of disease: many of the world's pandemics spread as viruses and bacteria hitched a lift with their invasive hosts (Diamond, 1997).

Some tend to think of this as a recent phenomenon, but it is as old as human expansion. Studies on the colonisation of the Pacific Islands by Polynesian and Melanesian peoples show how they brought with them their domesticated animals and rapidly impoverished the indigenous fauna and flora (Whittaker, 1998).

Human beings had other disruptive ecological effects. We set about the extermination of species which got in our way: in Scotland, this resulted in the fairly rapid disappearance of all the larger mammalian predators, plus beavers and some predatory birds. Further, our pastoral and agricultural activities radically altered vegetation patterns. All these factors de-stabilised Scotland's "natural" ecological communities and, arguably, provided conditions favourable to successful colonisation by alien species. In post-glacial Scotland, there is nothing more obviously alien than *Homo sapiens*.

Some extreme conservationists see human beings as such a major enemy of global biodiversity that the only solution is a major and rapid reduction of the human population. An alternative view sees humans as simultaneously part of nature and separate from the natural world. Our technological capacities create problems for the environment; our intellectual abilities help us to devise solutions; our moral attitudes drive us to do something about it. An influential ethical view gives humans a 'stewardship' role: we have a special responsibility for the long-term maintenance of the Earth, particularly its biodiversity. What could this mean in practice, particularly with respect to alien species?

There are two extreme approaches. The first is to be completely relaxed about species introductions: those suited to their new environment will thrive; those that are not suited will die out. On a geological and evolutionary time-scale, this is the logical approach, paralleling what has repeatedly happened in the colonisation of new islands and the evolution of new species. After all, what would we have thought of some officious early hominid who decided to wring the necks of the first few exhausted finches that made it to the Galapagos from Ecuador....

The opposite policy is to erect an ecological fortress. Decide on a time in history when the biodiversity of a particular area was stable and ideal, then rigorously root out and repel all species that don't make it on to the 'ideal' inventory.

Neither extreme is attractive. The laisser-faire approach ignores the fact that some alien species can be extremely damaging; and the fortress is simply not practical, even if we could agree on our ideal species list. The middle way is messier. It means making practical decisions on the basis of individual cases. How might such decisions be made, and are there any general principles that can help us?

I would suggest that most readers of this journal and most natural historians in general are in favour of maintaining the planet's reservoir of biodiversity, and avoiding actions that threaten it. Alien species are therefore a threat when their arrival has serious effects on populations of native species.

In a recent review, Daehler and Gordon (1997) conclude that effects are hard to predict, but that the number of genuine horror stories is fairly small. Here's one....The cichlid fishes of the great African Rift lakes are one of the fastest evolved and most exuberant species radiations we know of (Stiassny and Meyer, 1999). Lake Kenya has a recorded 400 species, most likely originating from a single ancestral species, as little as 14,000 years ago. In the late 1950's, against the advice of ecologists, the British colonial government decided to increase the fisheries productivity of Lake Kenya by introducing Nile Perch. For some time, the perch and cichlids appeared to co-exist, but in the last few years, populations of cichlids have declined drastically and many species are now believed to be extinct.

A general theory, with some experimental verification, is that diverse biological systems are more able to resist invasive aliens than less diverse systems (Stachowicz *et al*, 1999). The exceptions are isolated islands and lakes whose species may have evolved in the absence of certain classes of predator or disease organism, and are therefore highly susceptible to them. Therefore, the great diversity of Lake Kenya's cichlids was no defence against the Nile Perch.

However, some biologists have noticed the opposite effect, that alien species do best where diversity is greatest, possibly because high diversity is a reflection of a particularly rich environment (Enserink, 1999).

A recent study by Levine (2000) has attempted to resolve the issue. Levine studied sedge tussocks along a river bank in the USA: the tussocks are naturally diverse in native plant species, but are being invaded by three European species. He found that on the ecosystem scale, the more native species a tussock supported, the more invaders it had i.e. diversity did not deter invasion. But, when he manipulated individual tussocks to reduce the number of native species, the more diverse tussocks resisted invaders more effectively than the less diverse ones. Further work suggested that though diversity provided a bulwark against invasion on a very localised basis and in the short term, it had no longer term influence, if the number of invaders was great enough.

The cichlid case illustrates another common finding: that alien species can remain at low levels for considerable periods, before suddenly expanding rapidly in number. For example, biologists predicted, from the 1920's, that European zebra mussels would invade American freshwaters via ballast water carried by cargo vessels. By the early 1980's the zebra mussel might have been considered as a paradigm for how some species could not cross ecosystem boundaries. Then it took off, and now causes the North American water industry billions of dollars each year by clogging water pipes.

What we see here is fairly familiar in ecology: diverse individual cases but no over-arching general principles. This state of affairs won't necessarily persist. The increasing globalisation of the world economy means that the richest countries, especially the USA, with a strong presumption for free trade, now face a multitude of potentially damaging alien species. The US Department of Agriculture apparently intercepts around 2,000 potential pest species each year. Where there is a costly problem, funding opportunities open up. As a reflection of increased interest in the biology of alien species, a new journal *Biological Invasions* was launched in mid 1999.

If invasion biologists agree about anything at present, it is that the effects of alien species are hard to predict, a reflection of the complexity of all ecological interactions. In this sort of situation, conservationists tend to reach for the "precautionary principle" as many have done for genetically-modified organisms (GMO's): in other words, when in doubt, don't. This would amount to a presumption against the deliberate introduction into any "natural" environment of any species whose effects are potentially damaging to that environment's existing biodiversity.

In Scotland's case, given the many species which have already been introduced, deliberately or accidentally, the precautionary principle could be sensible to operate from now on. This would allow time for detailed studies of which species, amongst the aliens already here, are damaging to our environment.

Could we agree on that?

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Roger Downie

GLASGOW NATURALIST Vol. 23 Part 5 pp. 3-6 (2000)

LOCH LOMONDSIDE DEPICTED AND DESCRIBED: 3. EARLY GUIDE BOOKS FOR THE SCIENTIFIC TOURIST

JOHN MITCHELL
22 Muirpark Way, Drymen, Glasgow G63 0DX

"To the natural historian, Ben Lomond is no less interesting than to the traveller of mere curiosity"
Charles Ross (1792) *The Traveller's Guide to Loch Lomond*

INTRODUCTION

The earliest tourist guide books to Loch Lomond and the surrounding area appeared on the bookstalls just over 200 years ago, the very first written and privately printed by Charles Ross of Greenlaw near Paisley in 1792. Although quite distinct from the published accounts of 18th century travellers' itineraries which preceded them, these earlier descriptive works did make a tempting source of material for the writers of the new excursion guides to draw upon, on occasions 'lifting' whole passages word for word. Sir Arthur Mitchell (1901), in his classic review of early travellers' accounts relating to Scotland, dismissed most of the popular tourist guides which flooded the market as "mere compilations by persons who knew little of the locality described - who may, indeed, have never seen them". Despite having been bought by an eager public in their thousands, relatively few copies of these ephemeral works have survived the passage of time. Some issues have even acquired the status of collector's items, today's high asking prices bearing little relation to the shilling or two that they originally cost.

The content of 19th century Scottish regional guide books was more or less common to all: a cobbled-together collection of grand vistas, picturesque ruins, noblemens' country seats, literary associations with the district and the seemingly obligatory reference to at least one bloody skirmish from the country's turbulent past. As tourism continued to develop however, some popular guides did undergo at least a partial change in style. An explanation for this is given in the preface to the extensively revised 9th edition of Lizars' *Scottish Tourist* (1845). The editor, William Rhind (himself the author of several geological works), wrote ... "Such is the prevailing taste for scientific pursuits, that many tourists now blend the love of Natural Scenery with a devotion to Natural Science; for such, numerous notices of the Geology, Botany and Natural History of the various districts have been interspersed throughout this edition; and a Geological map, pointing out the leading formations, will be found among the illustrations".

This paper describes five guide books of the period which were tailored in part to the 'scientific tourist' visiting Loch Lomondside. Particular attention is drawn to the contributions made by two members of the Natural History Society of Glasgow.

THE SCIENTIFIC TOURIST THROUGH ENGLAND, WALES AND SCOTLAND (1818)

Thomas Walford (1752-1833), the first to introduce a scientific traveller's guide which included Scotland, was an Essex man of military background. He was elected a Fellow of the Linnean Society in 1797 and a Fellow of the Geological Society in 1825. His declared intention in publishing the work was to point out objects most worthy of notice to the antiquary, mineralogical and botanical tourist in every part of Britain. Arranged by counties, Scotland is covered in Volume two (Fig. 1).

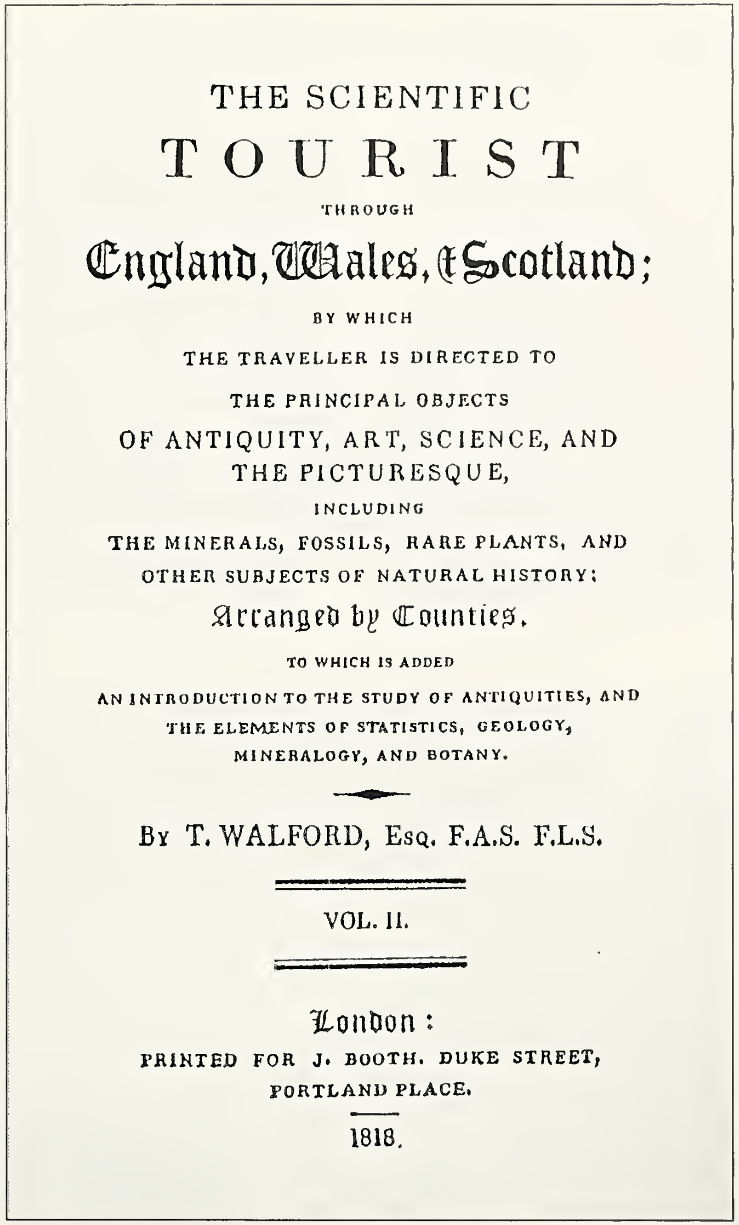
Despite the originality of the approach, no first-hand information on the Loch Lomond area is presented, most of the local material being extracted from the parish *Statistical Accounts* for Dunbartonshire and Stirlingshire published in the 1790s. Geological observations are mainly confined to the commoner rocks which occur in the two counties, although special mention is made of the collectable zeolites to be found in the lava flows of the Kilpatrick Hills. Walford's list of notable plants in the area is compiled from the Reverend John Lightfoot's *Flora Scotica* (1777).

DELINEATIONS; HISTORICAL, TOPOGRAPHICAL AND DESCRIPTIVE, OF THE WATERING AND SEA BATHING PLACES OF SCOTLAND (1822)

The author of the 'Delineations' - the Reverend William M. Wade (1784-1845) - came to Scotland from Oxford in 1817 to become the first Episcopalian minister for Paisley. He was elevated to Dean of the United Diocese of Glasgow and Galloway in 1843.

Fig. 1. *Walford's The Scientific Tourist* - in its day a novel approach to the regional guide.

Fig. 2. Maclure & Macdonalds' *Highland Route No. VII* was compiled by two members of the Natural History Society of Glasgow.



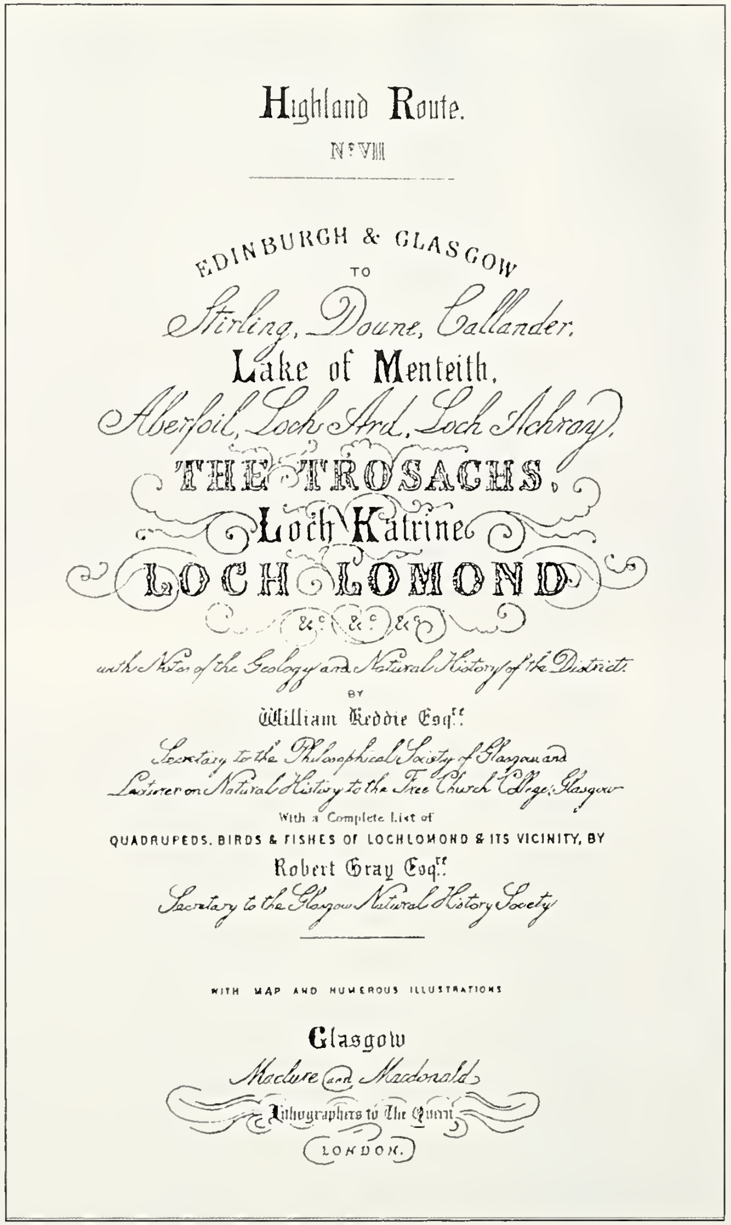
THE SCIENTIFIC
TOURIST
THROUGH
England, Wales, & Scotland;
BY WHICH
THE TRAVELLER IS DIRECTED TO
THE PRINCIPAL OBJECTS
OF ANTIQUITY, ART, SCIENCE, AND
THE PICTURESQUE,
INCLUDING
THE MINERALS, FOSSILS, RARE PLANTS, AND
OTHER SUBJECTS OF NATURAL HISTORY:
Arranged by Counties.
TO WHICH IS ADDED
AN INTRODUCTION TO THE STUDY OF ANTIQUITIES, AND
THE ELEMENTS OF STATISTICS, GEOLOGY,
MINERALOGY, AND BOTANY.

BY T. WALFORD, ESQ. F.A.S. F.L.S.

VOL. II.

London:
PRINTED FOR J. BOOTH, DUKE STREET,
PORTLAND PLACE.
1818.

Fig. 1



Highland Route.
Nº VIII

EDINBURGH & GLASGOW
TO
Stirling, Doune, Callander.
Lake of Menteith.
Aberfoil, Loch Ard, Loch Achray,
THE TROSACHS,
Loch Katrine
LOCH LOMOND
&c. &c. &c.
with Notes of the Geology and Natural History of the District.
BY
William Keddie Esqr.
Secretary to the Philosophical Society of Glasgow and
Lecturer on Natural History to the Free Church College, Glasgow
With a Complete List of
QUADRUPEDS. BIRDS & FISHES OF LOCHLOMOND & ITS VICINITY, BY
Robert Gray Esqr.
Secretary to the Glasgow Natural History Society

WITH MAP AND NUMEROUS ILLUSTRATIONS

Glasgow
Maclure and Macdonald
Lithographers to The Queen
LONDON.

Fig. 2

Wade's guide was written primarily for those seeking to regain or at least improve their health by drinking or bathing in the mineral waters of Scotland. Very conscious of the fact that the as yet barely commercialised watering places north of the border could not compete in the provision of entertainment compared with "the showy theatre, the gay assembly, the brilliant parade, the literary lounge or the dazzling repository of dress and decoration" of the fashionable spa towns of England, he turned instead to what Scotland had to offer by way of diversion in its scenery, natural curiosities and colourful history. For the general description of Loch Lomondside, Wade appears to have relied on *Ross's Traveller's Guide* (1792), but for his more scientific notes in the appended 'Memoranda in Natural History', he quotes liberally from the Reverend Patrick Graham's *Sketches Descriptive of Picturesque Scenery, on the Southern Counties of Perthshire* (1806) and Thomas Hopkirk's *Flora Glottiana* (1813), the first botanical work dedicated solely to Clydesdale.

GUIDE TO THE ROMANTIC SCENERY OF LOCH LOMOND, LOCH KATRINE AND THE TROSSACHS (1831)

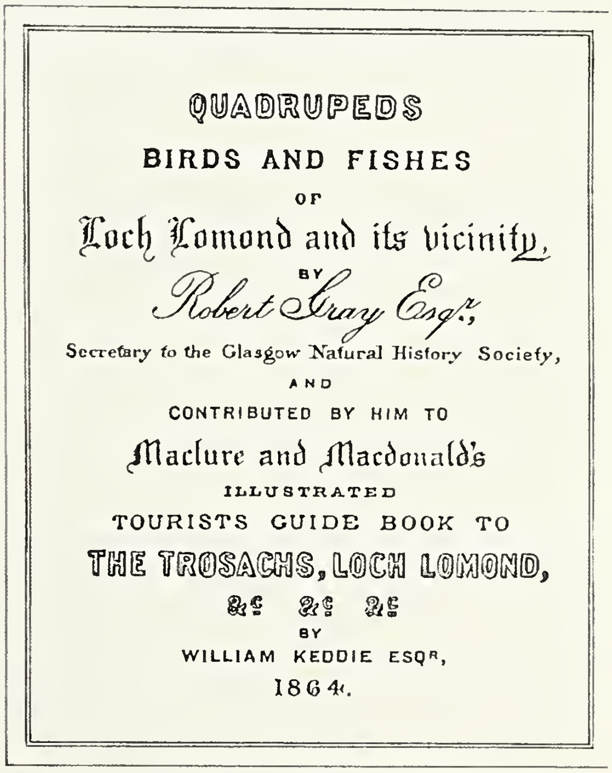
The publishing firm of James Lumsden & Son of Glasgow was among the leaders with best selling guide books almost from the start, their *Steam Boat Companion to the Western Islands and Highlands* (1820) going through several editions such was the demand. Lumsden's Guide to the Romantic Scenery of Loch Lomond etc. was to prove equally popular. This regional guide was probably first published in the late 1820s, although the earliest issue the present writer has been able to examine is a revised edition dated 1831.

For the most part, Lumsden and Sons' *Guide to the Romantic Scenery of Loch Lomondside etc.* offered the same descriptive material as all of its competitors, except for the inclusion of three pages devoted exclusively to the more interesting plants of the district and where they might be seen. This, it was claimed in an advertisement, would prove "a useful companion to the botanist". The plant list for the Loch Lomond area is divided into sections - Dumbarton Rock together with the River Leven, Loch Lomond itself and the adjacent mountains. Regrettably the compiler of the list is unacknowledged, but it is clear that the person was familiar with the botanical literature of the day, including William Hooker's *Flora Scotica* (1821).

THE NEW BOTANIST'S GUIDE TO THE LOCATIONS OF THE RARER PLANTS OF BRITAIN (1837)

This is a specialist work, its inclusion in this paper justified by one of the stated aims in the introduction "to form a guide book for the botanical tourist". The author - Yorkshire born Hewett Cottrell Watson (1804-1881) - studied medicine at Edinburgh University before devoting the rest of his life to his passion for botany, most notably the geographical distribution of plants in Britain.

The New Botanist's Guide is divided by counties, Volume two being devoted to Scotland. Of the published sources of information acknowledged, most frequent reference is made to *Hopkirk's Flora Glottiana* and Hooker's *Flora Scotica* for plants and their localities in the Loch Lomond area. What makes this compilation different from the others, however, is the inclusion of many previously unpublished records based on specimens in Watson's private collection. A large proportion of the herbarium specimens listed for Dunbartonshire and West Stirlingshire is credited to William Hooker's son Joseph, at the time a medical student studying at Glasgow University.



QUADRUPEDS
BIRDS AND FISHES
OF
Loch Lomond and its vicinity,
BY
Robert Gray Esqr.,
Secretary to the Glasgow Natural History Society,
AND
CONTRIBUTED BY HIM TO
Maclure and Macdonald's
ILLUSTRATED
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THE TROSACHS, LOCH LOMOND,
&c &c &c
BY
WILLIAM KEDDIE ESQR,
1864.

Fig. 3. Robert Gray's contribution to *Highland Route No. VII* as a separate publication.

HIGHLAND ROUTE NO. VII: EDINBURGH AND GLASGOW TO LAKE OF MENTEITH, THE TROSSACHS, LOCH KATRINE AND LOCH LOMOND (1864)

A founder member of the Natural History Society of Glasgow, the principal author of this work - William Keddie (1809-1877) - wrote several tourist guides to the west of Scotland for the Glasgow publishing house of Maclure & Macdonald. Hailing originally from Peebles, he began his working life at the age of thirteen as an apprentice printer in Glasgow. From the print shop floor, Keddie worked his way up to become editor of the *Scottish Guardian*. After 27 years with the *Guardian*, he made a change of career into education, teaching at several institutions in the city before being appointed Lecturer in Natural Science at Glasgow's Free Church College. Keddie had strong botanical leanings and evidently attended the classes of Professor J.H. Balfour at the University, continuing to participate in some of his mentor's field excursions to the Scottish mountains long after Balfour had departed Glasgow for Edinburgh University.

In many respects, Keddie's treatment of Loch Lomondside in *Highland Route No. VII* (Fig. 2) followed the by now well-trodden path. Over a page is devoted to the massacre of Glen Fruin and more than two pages to the life of Rob Roy. Having said that, the traveller with an interest in the physical features and wildlife of the region would not have been disappointed with the coverage given to natural history. Along with remarks on the geology and geomorphology of the area, selected plant lists for Ben Lomond, Ben Vorlich, Loch Lomond and Loch Sloy are given, unquestionably based on Keddie's own experience. For section 10 describing the zoology of Loch Lomondside, he turned for assistance to fellow founder member and Secretary of the Natural History Society of Glasgow, Robert Gray (1825-1887), resulting in no less than fifteen pages devoted to an introductory text followed by annotated lists of the district's mammals, birds and fishes. Apart from being the most generous zoological section to be included in any of the popular guide books available, equally unusual for this type of publication, Gray also issued his contribution as a 'separate' in its own right (Fig. 3).

Having come prepared with a selection of the more standard guide books for a royal visit to Loch Lomond in September 1869, Queen Victoria wrote in her journal that she and her entourage considered Black's *Picturesque Guide* was by far the best for the area (Duff, 1980), but it is unlikely the scientific tourist with a copy of Messrs Keddie and Gray's *Highland Route No. VII* tucked in his jacket pocket would have agreed.

ACKNOWLEDGEMENTS

Helpful assistance with locating copies of the tourist guides described in this account was given by the National Library of Scotland in Edinburgh, the Mitchell Library in Glasgow, together with Stirling and Dumbarton Library Services. My thanks also to Graham Hopner (Information Services Librarian at Dumbarton) for his constructive comments on the draft manuscript and to Norman Tait who prepared the illustrations for publication.

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THE FLORA OF THE COATBRIDGE COUP

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Household refuse tips are well known as sites for unusual alien plants. In general these come from kitchen vegetable material, garden refuse and the debris from bird cages. In a previous paper (Macpherson & Macpherson, 1981) a comparison was made of the flora of two tips in the Glasgow area. These have now been closed and grassed over. However, material for disposal from Glasgow still goes to the coup north of Coatbridge, Lanarkshire (VC 77). As regular visits have been made to the site since 1993, and as it is due to close in 2000, it is considered appropriate to put on record some of the findings.

SITE

The area was initially a natural hollow and in the early part of the 20th century was used as a pit for dumping material from an adjacent brickworks. In 1932 it became a coup for household refuse. Initially the material was simply dumped and spread out but recently there had been a requirement for household refuse to be covered within 24 hours. When possible, rubble is used but its availability has been reduced since imposition of the landfill tax. In the main, material for covering is now dug out from the periphery of the site. The result is that there is now a hillock dominating the surrounding relatively flat countryside. Over half the area on top was levelled three years ago to form a plateau. Recently, each working day a Harris Hawk is tethered on the edge of the plateau overlooking the residual dumping area. Whereas, in previous years there were hordes of seagulls, none were seen in the vicinity during two visits in 1999.

METHODS

With permission from the Glasgow City Council Cleansing Department, the site has been visited at regular intervals over the past seven years. During the early survey period showy flowering plants were to be seen over most of the site, but since the material has been covered, the plants have been fewer in number and variety. However, interesting finds can still be made round the edges of the working area.

RESULTS

Over the survey period a total of 177 different plants has been recorded. Of these 125 are native, in the main, either on unworked sections or by natural dispersal from surrounding areas. Of particular note in this connection is the assemblage of plants on the plateau. Although relatively flat, there are numerous small hollows where rainwater collects. Despite the relative altitude and the fact that it is windswept, in the three years since it was flattened it has become colonised by plants of wetlands and pools. In addition to soft-rush (*Juncus effusus*), jointed rush (*J. articulatus*) and red bartsia (*Odontites vernus*) of damp areas, reed mace (*Typha latifolia*), branched bur-reed (*Sparganium erectum* spp. *microcarpum*), mare's- tail (*Hippuris vulgaris*), tufted forget-me-not (*Myosotis laxa*), common spike-rush (*Eleocharis palustris*), bladder-sedge (*Carex vesicaria*) and floating sweet-grass (*Glyceria fluitans*) grow in relation to the pools. The bur-reed subspecies had previously been recorded in the adjacent 1km square and the bottle-sedge (Keith Watson) 2km distant, in its only other extant Lanarkshire site.

Sixteen native grasses were recorded, four waste ground plants including viper's-bugloss (*Echium vulgare*) and mignonette (*Reseda lutea*), three rushes, one sedge and one fern. Around the base there are five shrubby trees, mainly willows.

Although native in Britain, some plants undoubtedly arrive on site as a result of man's activity and, strictly speaking, should be classified as aliens (Macpherson *et al*., 1996). Lesser sea-spurrey (*Spergularia marina*) is a prime example. This sea-side plant, now widely established along the roads in Lanarkshire (Macpherson & Macpherson 1998) was seen as a single clump on a ledge about 20 ft below the plateau. Otherwise the most noteworthy native seen was red goosefoot (*Chenopodium rubra*). This is a plant of cultivated and waste ground and tips, frequent in much of England but rare elsewhere (Stace, 1997). It is usually seen in small quantity but on this site has been the most common plant. Over the survey period many hundreds have been present, particularly on the eastern slopes and ledges. However the main purpose of the survey was to record those plants which are alien to Britain.

Many of the aliens are of widespread occurrence on roadside and waste ground e.g. *Epilobium ciliatum* (American willowherb), *Matricaria discoidea* (pineappleweed) and *Senecia squalidus* (Oxford ragwort). The more interesting aliens have been classified according to the probable source. Those considered to have had a kitchen origin are *Lycopersicon esculentum* (tomato) and *Solanum tuberosum* (potato). Twenty two species are believed to have had a garden origin and are listed in Table 1. Of the 14 plants which are presumed to have originated from bird-seed (Table 2), it is possible that some had another source of introduction. *Avena sativa*, *Brassica rapa* and *Pisum sativum* could be relics of cultivation and *Sisymbrium altissimum* and *S. orientale* are considered to be either bird-seed or grain seed aliens (Clement & Foster, 1994). *Trachysperma ammi* was the rarest plant recorded and could either have been a spice or bird-seed alien.

Table 1. Garden refuse plants recorded on the Coatbridge coup 1993-99.

Antirrhinum majus	snapdragon
Buddleja davidii	butterfly-bush
Centaurea montana	perennial cornflower
Cotoneaster bullatus	hollyberry cotoneaster
Crocosmia x crocosmiiflora	montbrecia
Erysimum cheiri	wallflower
Eschscholzia californica	Californian-poppy
Geranium x oxonianum	Druce's crane's-bill
Helianthus annuus	sunflower
Helianthus rigidus	perennial sunflower
Iberis umbellata	garden candytuft
Limnanthes douglasii	meadow-foam
Lonicera nitida	Wilson's honeysuckle
Lunaria annua	honesty
Pilosella aurantiaca spp.carpathicola	fox-and-cubs
Potentilla fruticosa cv.	shrubby cinquefoil
Prunus laurocerasus	cherry laurel
Rosa rugosa	Japanese rose
Spiraea x pseudosalicifolia	confused bridewort
Tanacetum parthenium	feverfew
Vinca minor cv.	Lesser periwinkle
Viola lutea cv.	mountain pansy

Table 2. Presumed bird-seed aliens recorded on the Coatbridge coup 1993-99.

Avena sativa	cultivated oat
Brassica rapa	turnip
Chenopodium strictum	striped goosefoot
Chenopodium suecicum	Swedish goosefoot
Lepidium sativum	garden cress
Linum usitatissimum	flax
Melilotus indicus	small melilot
Panicum miliaceum	common millet
Phalaris canariensis	canary-grass
Pisum sativum	pea
Sisymbrium altissimum	tall rocket
Sisymbrium orientale	eastern rocket
Trachyspermum ammi	ajowan
Triticum turgidum	rivet wheat

DISCUSSION

In the previous article (Macpherson & Macpherson, 1981) comment was made that at one refuse tip the material was deposited in the crude state, while at the other the refuse was subjected to high density baling before deposition. There were fewer plant species at the latter. It was concluded that the treatment resulted either in a poorer medium for plant germination or that it had a smothering effect.

The reduction over the years in the quantity and diversity of aliens seen at the Coatbridge coup is similarly related to the smothering effect of the daily covering of the deposited refuse material.

Although still of interest, botanising on refuse tips is not now as rewarding as it was in the past.

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OBSERVATIONS ON IRISH LADY'S-TRESSES ORCHID (*SPIRANTHES ROMANZOFFIANA*) ON COLONSAY (VC102)

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INTRODUCTION

Spiranthes romanzoffiana has recently been added to the list of plants for which a Species Action Plan has been prepared as part of the government's commitment to conserving biodiversity following the Rio de Janeiro convention in 1992. Scottish Natural Heritage and the Royal Botanic Garden, Edinburgh have monitored the species from 1990 to 1996, with a peak of survey activity in 1995. In that year the plant was found in 12 out of a set of 76 sites from which it had been reported at some time in the past i.e. 16%. This would appear to indicate that at many sites the plant had become locally extinct. On the other hand in just that one year, 1995, 15 'new' populations were discovered. Furthermore in some cases where a site was visited in two different years in the period 1990 to 1996, *Spiranthes romanzoffiana* was found on one occasion but not on the other. The exact status of the species is therefore extremely difficult to determine.

Spiranthes romanzoffiana can be very hard to detect in the field. The plant has narrow grass-like leaves; and the creamy white inflorescence can be hidden in taller vegetation. Flowering stems can be partly or wholly grazed by cattle, sheep and rabbits. Slug grazing also occurs. The stem is delicate and easily damaged by trampling. The plant can produce basal leaves without producing a flowering stem (Dr Neil Cowie *pers. comm.*: Dr James Robarts *pers. comm.*). Dr James Robarts started his population counts on Barra in 1988. Detailed monitoring work has been carried out on seven populations since 1992. The following example has been selected from his large (unpublished) data set to emphasise the potential of the species to survive underground. One plant flowered in 1993 then survived for four years underground without generating any above ground tissue. In the sixth year it produced above ground growth. The related *Spiranthes spiralis* has been shown to subsist for at least a year below ground and still flower the following year (Wells, 1967). Failure to detect *Spiranthes romanzoffiana* may frequently be due to its cryptic characteristics. In addition some (or all) members of small populations may be in a vegetative state and some (or all) may be in the underground phase at the time the site was visited.

Tubers produced by the orchidoid orchids e.g. in the genera *Dactylorhiza*, *Orchis*, *Orphrys*, and *Platanthera* originate as axillary shoots and are usually only infected by mycorrhizal fungi in peripheral extensions and in superficial tissue (Rasmussen, 1995 pp. 135-136). By contrast in the genus *Spiranthes* all roots are tuberous when young; the roots become more slender as they get older. In addition to serving as storage organs they are usually heavily infected by mycorrhizal fungi (Rasmussen, 1995). It is therefore possible that the special structure and degree of infection in the tuberous roots of plants of the genus *Spiranthes* permits survival underground for sustained periods.

The following observations mark a first step in a series of investigations to learn more about the biology of the species, and therefore assess more fully its conservation status and site management requirements. In Britain *Spiranthes romanzoffiana* has one station in Devon, otherwise it occurs in Scotland, concentrated in the Hebrides, but with some records from the mainland at or fairly near to the west coast (Horsman, 1994). The only other European locations for this North American and Asian species are Northern Ireland and the Republic of Ireland.

SCOPE OF THE STUDY

The survey of plants on Colonsay in 1999 involved searching the fourteen sites at which *Spiranthes romanzoffiana* was detected in bloom in 1995 and/or in 1996 (see Gulliver 1996, 1997), together with some potential new locations. Two of the 1999 sites were from the 1995 and 1996 set (pooled); one was discovered in 1997, and the remaining two were found 'new' in 1999. Eighty six plants in bloom were detected in total. These results indicate that on Colonsay, as elsewhere in Scotland, only a minority of sites contain plants in flower in any one given year.

Figure 1 (A-D) shows photographs of the orchid at different stages in its development.

RESULTS

Lateral buds and vegetative reproduction

Plants of *Spiranthes romanzoffiana* frequently have a small lateral bud at the base of the flowering stem, and these are usually visible from August onwards. Two or more buds can sometimes be produced (Summerhayes, 1968); and this would appear to be the main means of vegetative reproduction. No examples of multiple buds were detected on Colonsay in 1999. However at one site with 49 plants, two flowering stems were separated by 14cms. At another site with 25 plants two flowering stems were separated by 7cms, and another two by 17cms. In each case these 'twinned' plants may have originated in previous years from paired buds. At one of the Colonsay sites investigated on 16:8:95 (Gulliver, 1996), three flowering stems were separated by 2 and 4cm, and another two stems were separated by 2cm within a total group of 6 plants. On 7:8:96 there was one plant present at this site, which had a developmental anomaly. The basal parts of the upper two stem leaves had fused, and were trapping the top of the inflorescence. The status of sites in 1996 is described in Gulliver (1997). No plants were detected at this particular site in 1999.

Seed production

A drawing of a seed (described as 'unripe' but with surface texture) of *Spiranthes romanzoffiana* appears in Butcher (1961). The code letter on the drawing appears to indicate that the plant was located at Lough Neagh, Northern Ireland. Horsman (1994) states 'there is no direct evidence of cross-pollination in Britain, and our populations are believed to reproduce entirely vegetatively'. No seed has ever been found in the seven populations of plants monitored by Dr James Robarts on Barra. None of the plants which survived grazing at the five sites on Colonsay in 1999 produced seed. For one plant specimen which had a brown, senescing stem; 5 green capsules were present, the valves of which had started to split apart when observed on 22:9:99. One of these capsules was examined, the rest were left in situ. This capsule contained only ovules. These were considerably smaller than the seed figured in Butcher (1961), and no surface pattern was discernible. Given the time of year and state of the plant it was impossible that these ovules would develop into seeds.

Figure 1 (back cover)

Irish lady's-tresses orchid (*Spiranthes romanzoffiana*), various stages

A. Whole plant showing the spiral arrangement of the flowers, photographed on 7:8:95: The lowest bloom has already withered. Note the grass-like leaves: the left hand leaf is truncated due to grazing.

B. Inflorescence: in the older flowers the lateral margins of the labellum (lip) have become in-rolled. 16:8:95.

C. Withered stem and inflorescence 15:9:99; stem and inflorescence dead with no sign of capsule development, (first site). It would be very difficult to detect plants in the field at this stage if the exact location was not already known. By contrast the robust, dead stems and fibrous capsules of some members of the Orchidaceae, e.g. *Dactylorhiza fuchsii* and *maculata* are relatively conspicuous in the autumn.

D. Lateral bud: by 12:10:99 the largest leaf in this lateral (basal) bud was 2.2cm, and the third leaf is just visible in a central position. Most lateral buds on the plants on Colonsay in 1999 were not as large as this by this date; (second site).

Sheep grazing and inflorescence survival

The five 1999 sites have been graded in relation to the impact of sheep grazing and numbered one to five. The first site was ungrazed throughout August, September and early October. On 15:9:99 all eight plants had a shrivelled inflorescence still in place. Plants frequently occur in small groups up to 5m across, but usually much less. At this site in 1999 there was a group of 3 and a group of 4, plus a single plant. In 1995 a group of 2 was present, and in 1996 a group of 5.

At the second site sheep were present in the area on 15:8:99, but there had been no grazing in June, July and the beginning of August. On 14:8:99 there were 49 plants in bloom. By 1:9:99 sheep grazing had produced a 73.5% loss of flowering spikes. In a sample of 20 (the most south easterly plants) the loss was 65%, i.e. 7 remained. However on 22:9:99 5 of these inflorescences (25%) were still present, though in a withered state. One included the 5 green capsules which were dehiscing. These capsules had 'developed' despite a partial fracture to the stem, presumably due to trampling. It is interesting to postulate that had fertile seed been produced it might well have reached maturity and been shed in circa 20% or more of the population of plants at this site, i.e. those that escaped the impact of sheep grazing. However it is possible that the grazing impact would be more intense on stems with fertile capsules, which would probably remain green, upright, and more or less full sized to support the capsules and supply nutrients to the developing seeds.

The third site was grazed by the same flock of sheep as the second. Twenty four flowering spikes were present on 14:8:99; with a late flowering 25th spike appearing by 1:9:99. By 9:9:99 4 withered spikes survived, by 15:9:99 3. By 22:9:99 there was one, which was still present on 12:10:99. This consumption would naturally include any developing fertile seed that might have been present. The difference in grazing intensity on the two sites may well be due in part to a) relative dryness of the ground, b) quality of the herbage around the individual *Spiranthes romanzoffiana* plants, and c) shelter provided by the surrounding small scale land forms.

A single plant growing on 26:7:99 at the fourth site (which was close to the third site) had disappeared by 1:9:99, presumably due to sheep grazing.

The start of the steady disappearance of flowering spikes at sites two and three coincided with the reintroduction of sheep. However it is possible that slug grazing was also an important factor. On Barra slug grazing is the main cause of damaged and consumed spikes in the summer months for the seven study populations. (Dr James Robarts, *pers. comm.*). Stock are normally absent during this period. The impact of slug grazing on the lateral buds of plants on Colonsay is described subsequently.

At the fifth site (located a considerable distance away from sites one, two, three and four) the three inflorescences present on 4:8:99 had been consumed, probably by sheep, by the 25:8:99.

Slug grazing and lateral buds

The fact that the sites are graded in intensity of sheep grazing allows a preliminary assessment of the impact of slug grazing on the lateral buds. There were eight plants at the first site (with no sheep grazing), all of which had intact lateral buds on 15:9:99. Five plants were located away from the loch margin. On 13:10:99 the top of the lateral bud had been grazed in four of these five plants. In one case the withered stem was intact and upright only 2mm away from the bud. In another case the grazed top of the bud was 5mm below the surface. Both these facts strongly indicate slug grazing. The other three plants were on the margin of the loch. Two were locatable on 13:10:99, and had intact buds. The third was under water at the time of the visit. It seems highly likely that the fluctuating water level had reduced slug numbers and hence slug grazing activity.

At the second site, 11 lateral buds were observed when the location of the 20 south easterly plants was examined on 22:9:99. Despite the use of discrete markers, no above ground tissue (dead stems, withered basal leaves or lateral buds) was detected for 7 out of 20 of these plants. The locations of a further 21 plants were examined on 11:10:99. 7 plants were detected, each of which had a lateral bud. The presence of surface water prevented the relocation of the position of the remaining 8 plants. None of the 18 lateral buds showed any sign of slug grazing. However at this site it did appear possible that very severe grazing by sheep on the stem, stem leaves and basal leaves might have had an inhibitory effect on subsequent lateral bud production. This possible interaction will be investigated using a bigger sample in 2000.

At the third site, lateral buds were detected at the location of 10 of 25 plants on 12:10:99. Two of these had truncated tops, presumably due to slug grazing.

Lateral buds were not examined at sites four and five.

Structure of inflorescence

Two examples of plants with two ranks of flowers rather than three were observed at the second site. No previously published account of this phenomenon occurring at a specific site in Scotland has yet been detected. In America plants with two, three, or four ranks have been observed (Cronquist *et al.*, 1977); and a general account of the orchids of Europe mentions the possibility of two ranks of flowers being present (Sundermann, 1975).

DISCUSSION

The distribution of *Spiranthes romanzoffiana* will be limited to sites where conditions are at least adequate for the survival of both its below and above ground organs; and for the requirements of its fungal associate. (The normal situation within the Orchidaceae is for any one orchid species to be able to co-exist with one of several potential fungal associates). Whereas grazing by sheep and other vertebrates may result in a medium to high loss of above ground tissue; nevertheless grazing at a suitable intensity may produce general habitat conditions which are favourable for survival of the orchid/fungus combination in the long term.

If, as appears to be the case, production of fertile seed is a rare event in Scotland, then grazing may have a major impact if either only a few capsules are produced in a population, and/or if seed is only produced at infrequent intervals. In these cases grazing may well significantly reduce the likelihood of the species colonising new sites to replace extinction at current sites which will inevitably take place due to a range of natural and man-influenced processes. (It is anticipated that levels of slug grazing are unlikely to vary greatly from year to year, but confirmation or otherwise of this proposition is desirable). It is hoped that future observations will shed further light on these matters.

Extensive survey work in Scotland is also being undertaken, and any records of the reappearance of the plant at old locations, or its discovery at new sites, would be gratefully received by the authors.

ACKNOWLEDGEMENTS

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NATURAL REGENERATION OF LIMES (*TILIA* SPP.) IN SCOTLAND: Locally widespread and more numerous in 1999

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ABSTRACT

This paper explores the degree of lime regeneration found in Glasgow and other parts of Scotland in 1999. Regeneration was more widespread than noted previously, although summer temperatures in 1997, the year producing the fertile seeds, were not the hottest on record nor in the past decade. Detailed analysis of regeneration in one specific locality reinforced the general trends found elsewhere. We noted more vigorous development of seedlings having three cotyledons compared to those with the normal two. The higher threshold temperature sensitivity of small-leaved lime (*T. cordata*) compared to that of large-leaved lime (*T. platyphyllos*) and common (hybrid) lime (*T. x europaea*) were reflected in the seedling counts.

INTRODUCTION

Our previous paper forecast that "much (lime) regeneration can be anticipated in 1999 on the basis of the 1997 temperatures" (Gray *et al*,1999). Since it was written, this forecast was substantiated by lime regeneration mainly in the Glasgow area, and also to a lesser extent elsewhere.

REGENERATION IN 1999

Our earliest observation of lime seedlings (common lime, *T. x europaea*) was on 26th March, 1999 in the garden of 9 Victoria Circus in the West End of Glasgow. Three were noted.

The 1999 results show firstly, that common lime regeneration was locally abundant, measurable in hundreds, and greater than the local numbers found in previous years. Secondly, common lime regeneration was more widespread in the West End of Glasgow than in previous years. We observed it in 25 sites compared with 14 in 1998: the same sites were examined in both years.

The scale and relative increase in seedlings in 1999 is illustrated by counts of new seedlings at Hyndland Court, 6 Sydenham Road: NS 560675, which numbered 53 in 1997, 16 in 1998 and 275 in 1999 – a remarkable increase in this last year.

Small-leaved lime (*T. cordata*) regeneration showed an increased number of seedlings at three locations as opposed to two.

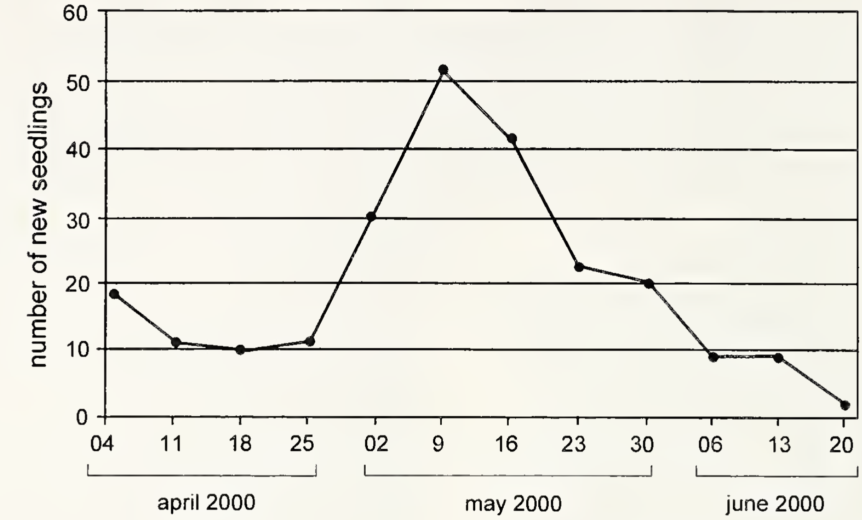
Large-leaved lime (*T. platyphyllos*) regeneration followed a similarly increased pattern in terms of number though not of location.

In the Milngavie area natural regeneration was observed in only two areas, namely, Auchenhowie – under a curious hybrid that may be a backcross – and the Community Education Centre – under *T. platyphyllos*. The paucity of natural lime regeneration in the Milngavie area may have been due to excessive moisture, causing ground conditions to be unsatisfactory for germination. Germination occurred in spring, 1999 of large-leaved lime seeds previously collected from six locations in the Milngavie area, namely, Allander walkway, C.E. Centre, Drymen Road, Kilmardinny House and the wooden bridge on Clober Road (Hansen, personal communication).

Flowering of *T. platyphyllos* was first noted in the Milngavie area on 9th July, about two weeks after flowering at the lower, more sheltered altitude of the West End of Glasgow.

Outwith the Glasgow area 48 seedlings were found under a number of large–leaved limes in the grounds of Dalzell House, Motherwell where also 10 seedlings were discovered under a few common limes. Some 63 seedlings were observed under a single *T. platyphyllos* in the Royal Botanic Garden, Edinburgh in the spring of 1999. Reports were received of regeneration of *T. x europaea* in Darvel, Ayrshire and Cardross, Dunbartonshire. Hence it is evident that limes can produce fertile seed over a wide part of the central lowlands of Scotland from Glasgow to Edinburgh, Ayrshire, Dunbartonshire and north Lanarkshire. Previous reports extend this area as far north as Perth (Gray *et al.*, 1999).

Figure 1: **Numbers of new seedling limes (*T.x europaea*) emerging each week in Plot A, Hyndland Court, Glasgow – 1999**



Hyndland Court

New seedlings in the whole garden numbered 275 in 1999, most of them in one grass plot. Close observations of this 64 m2 plot of mossy grass with one of the row of limes (*T. x europaea*) in its corner showed a total of 235 emergent seedlings in April-June, most of which surfaced in early May (Fig. 1). Three of these had three instead of the normal two cotyledons. Two of these were potted, as were 5 of the normal seedlings, one of which died. It was soon evident that the seedlings with three cotyledons grew more vigorously than the others (Table 1). All those in pots, including five from 1998 and one from 1997, survived in the roof garden whereas most of those in the ground below were destroyed by gardeners strimming, damaged by trampling or grazed apparently by invertebrates as in previous seasons, or plucked for pressing before the gardeners strimmed the plot in July. Invertebrates damaged leaves in the roof garden also, including the darker green leaves of seedlings 99.1 & 99.2 which were reduced to lacework.

The crop of 235 seedlings under one lime contrasts with the single seedling in a similar area of mossy grass a few metres farther north in the garden adjacent to two other common limes in the same row. This difference further supports our view that the different genetic constitution of individual limes is important to their ability to produce fertile seeds.

FACTORS AFFECTING REGENERATION

Temperature

It was on the basis of the temperature data above the 20 degree threshold for both July and August, 1997 that the forecast was made of substantial lime regeneration in 1999. If temperature were the sole determining factor controlling lime fertile seed formation and subsequent regeneration the number of seedlings anticipated in 1997 (on the basis of the 1995 temperature data) would have been greater than in 1999.

Table 1: Comparison of potted seedlings in July & September, 1999

Seedling no.	No. of cotyledons	Leaves (no.)	Leaves (no.)	Leaf max. size (mm.)	Height (mm.)	Height (mm.)	No. lateral branches
		25 July	12 Sept	12 Sept	25 July	12 Sept	12 Sept
99.1*	3	7+	5+	42	40	45	2
99.2*	3	9+	9	45	35	43	2
99.3	2	3	3	n.r.	25	33	0
99.4	2	2	0 eaten	0	15	33	0
99.6	2	n.r.	1	remnant	n.r.	30	0
99.7	2	n.r.	3	tiny	n.r.	25	0

n.r. = not recorded
Leaf numbers reduced in late summer by predation by slugs etc.
* = on Aug. 3rd these seedlings were potted on because of their more vigorous growth.

The opposite was the case. The 1996 temperatures suggest less germination in 1998 than in either 1997 or 1999 as was certainly the case for both *T. x europaea* and *T. platyphyllos*. The lack of precise correlation between temperature and amount of regeneration indicates the operation of factors other than temperature alone in controlling lime regeneration. Exact correlation is not to be expected since the temperature records were not from within the northwest area of Glasgow itself. Also environmental conditions between the time of fertilisation and regeneration may differ.

The smaller amount of *T. cordata* regeneration observed reflects the higher temperature requirement for fertilisation compared to *T. platyphyllos* and *T. x europaea* (Pigott, unpublished).

On the basis of the 1998 temperature data, adjusted to sea level, since neither the July nor August figures achieved the 20 degree threshold, it was anticipated that little or no new germination would occur in spring, 2000. In the event, however, from March 19th, 2000 the cotyledons of new seedlings have been appearing under *T. x europaea* and *T. platyphyllos* and our observations continue. These seedlings may result either from fertile fruit formation in 1998 or represent the remains of the 1997 fruiting year.

Moisture

It has been shown experimentally (Pigott, 1991) that if seed is air dried and then sown in the open, 10 – 15% germinate after 6 months and most of the remainder after 18 months. Seed hanging on the tree is normally subjected to air drying prior to fall. Hence it was suggested in our previous paper that "If the 1998 regeneration developed from the fertilisation of the 1997 hot summer then, on a moisture basis, the anticipated percentage germination in 1999 in this area might be considerably more than in 1998." The regeneration numbers for 1999 clearly substantiate this claim. The figures also suggest that the 1998 regeneration resulted from 10 – 15% of the 1997 fertilised seed, although it is possible that some of this 1998 regeneration arose after 18 months from 1996 when the July/ August monthly mean temperature maxima almost reached the 20°C. threshold.

SURVIVORS

Survivors refer to specimens one or more years old, i.e. survivors from previous years.

It is apparent from the tables that survival of any seedling beyond the one year stage is fairly uncommon in this area. The apparent decline of *T. platyphyllos* numbers from 10 to 6 probably has more to do with the difficulties associated with observing these saplings within a tended privet hedge than any real change in their numbers.

Table 3: Sites of Natural Regeneration 1999

Table 2: Summary of Lime Regeneration in 1997, 1998 & 1999

species	survivors '99	survivors '98	New in '99	New in '98	New in '97
T. x europaea	7 (0 saplings)	24 (0 saplings)	several hundreds	>50<100	100's
T. platyphyllos	12 (incl. 6 saplings)	36 (incl. 10 saplings)	145	13	>40
T. cordata	2 (incl. 2 saplings)	3 (incl. 2 saplings)	20	2	0

Table 4: Monthly Mean Temperature Maxima (degrees C.)
(Mugdock* 1999, Abbotsinch 1998 to 1996 and Renfrew 1995)

	1999	1998	1997	1996	1995
June	15.6	16.7	17.9	18.0	19.5
July	18.9	17.9	20.3	19.2	20.8
August	18.1	18.5	21.6	20.2	22.8
September	16.6	17.0	16.6	17.7	16.7

Mugdock (160 metres above sea level) temperatures amended using the lapse rate of 1°C. per 160m

T. x europaea

9 Victoria Circus. On 26/3/99 – 3 seedlings.
Hughenden Lane. SE corner of playing fields. On 9/4/99 – 1 seedling.
Princes Place / Prince Albert Road. On 9/4/99 – 1 x '98 survivor in hedge.
Great Western Road. N side. Balgray. On 9/4/99 – 20 seedlings.
'Stazione' restaurant area. On 9/4/99 – 24 seedlings.
Hughenden rugby stand. On 9/4/99 – 16 seedlings.
6 Prince Albert Road lawn. On 12/4/99 – 33 seedlings.
N-D school garden. On 12/4/99 – 4 seedlings.
Glasgow Botanic Gardens. On 12/4/99 Under T. 'Petiolaris' – 6 seedlings. Under T x europaea – 1 seedling.
9 Victoria Circus. On 12/4/99 – 15 seedlings.
Balgray, W gate. On 14/4/99 – 5 seedlings.
6 Prince Albert Road back garden. On 14/4/99 – 20 seedlings.
6 Prince Albert Road front garden. On 14/4/99 – 33 seedlings.
Dalzell House grounds. On 25/4/99 – 10 seedlings.
Baron's Haugh. On 25/4/99 – 1 seedling.
6 Prince Albert Road front garden. On 26/4/99 – 83 seedlings.
6 Prince Albert Road back garden. On 26/4/99 – 38 seedlings.
3 Sydenham Road. On 30/4/99 – 5 seedlings. 1 x '98 survivor in hedge.
6 Sydenham Road. Between 2/4/99 & 20/6/99 – 235 seedlings (cf. Fig.1)
8 Sydenham Road. On 30/4/99 – 3 seedlings.
Prince Albert Road, S side. On 4/5/99 – 1 seedling.
N-D school garden. On 4/5/99 – 4 seedlings.
Crown Road North. On 4/5/99 – 30 seedlings. 4 x '98 survivors in hedge.
Crown Terrace. On 4/5/99 – 2 seedlings.
'Rock' car park. On 4/5/99 –5 seedlings.
Laurel Park School, Great George Street. On 13/5/99 – 1 seedling.
Lilybank Gardens. On 13/5/99 – 3 seedlings.
Queen's Gardens. On 13/5/99 – 5 seedlings.
Princes Terrace. On 13/5/99 – 10 seedlings.
Great Western Road, S side. On 20/6/99 – 6 seedlings.
9 Victoria Circus. On 25/7/99 – 4 surviving '99 seedlings.
BT Linfern Entrance. On 1/8/99 – 10 surviving '99 seedlings.
10 Victoria Circus. On 1/8/99 – 8 surviving '99 seedlings.
Marchmont Terrace. On 27/8/99 – 1 surviving '99 seedling.

T. platyphyllos

Kingsborough Gardens. On 9/4/99 – 13 seedlings. 2 saplings flushed in hedge.
Marchmont Terrace. On 12/4/99 – 69 seedlings.
Dalzell House grounds. On 25/4/99 – 48 seedlings.
Kingsborough Gardens. On 4/5/99 – 14 seedlings. 2 x '98 survivors, 6 older survivors.
Knightswood Triangle. On 5/5/99 – 1 seedling.
Marchmont Terrace. On 27/8/99 – 27 surviving '99 seedlings. 4 x '98 survivors.

T. cordata

Kingsborough Square, N side. On 9/4/99 – 2 seedlings.
Kingsborough Square. On 4/5/99 – 12 seedlings.
Crown Terrace. On 4/5/99 – 2 seedlings.
Victoria Circus, Northcote Surgery. On 1/8/99 – 4 x '99 survivors.

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THE HISTORY, HABITAT AND PRESENT STATUS OF HOLY GRASS (*Hierochloe odorata*) (L.) P. Beauv. AT BLYTHSWOOD, RENFREW DISTRICT, VC 76

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INTRODUCTION

Holy grass (*Hierochloe odorata*) is a plant of wet grassy places and tidal river margins. This grass is widespread in Asia, Europe and in North America where it is known as sweet grass or vanilla grass (Hubbard, 1968). In Britain, holy grass is a nationally rare plant and is classified as a lower-risk, near-threatened Red Data Book species. In Scotland, which has almost all of the British records, holy grass has been recorded as present in 17 of the 10 km2 (Wigginton, 1999). Most of these sites are on or near the coast, river estuaries and tidal river margins. Some inland locations have also been discovered. Holy grass was first identified as a British plant in an Angus glen by George Don in July 1812 (Hooker, 1821). Don was a Scottish botanist and his discovery was published under the name of Northern Hierochloë (*Hierochloë borealis* Roem. & Schultz). For many years searches were made by enthusiastic botanists at the Angus site but the holy grass eluded them (Bennett, 1899). It was not until 1854 that a second station was discovered at Thurso. The plant was now becoming recognised as a Scottish species and, over the years, new localities have been added to the list. The Renfrew site was discovered in the early 1930's. The generic name *Hierochloe* is derived from the Greek *hieros*, "sacred", and *chloë*, "grass"; hence holy grass. The specific name *odorata* refers to an aroma produced from the plants which some have described as being like vanilla or coumarin. Holy grass is the first perennial grass to flower, sometimes in March, but more usually in April and May and is most easily identified in springtime. It spreads rapidly by means of slender creeping rhizomes which form compact patches. The genus was called *Hierochloe* because in some parts of Prussia the plant was dedicated to the Virgin Mary and was strewn around churches at festivals (Hooker, 1821), the sweet scent from the grass no doubt helping to disguise dampness arising from the earthen floors. Linnaeus states that the grass is a soporific and sold in Swedish towns "to be suspended over the beds and induce sleep." (Hooker, 1821). These practices have not, as far as is known, been recorded in Scotland. Many of the Scottish locations are, however, in the vicinity of ancient ecclesiastical sites.

HISTORY OF THE AREA

The rivers and land surrounding the holy grass sites have undergone dramatic changes over many centuries. In 1796 the White Cart Water was widened, deepened and straightened. A canal cut was made to the east of the former channel so avoiding shallows at the Inchinnan Bridge. This canal allowed larger ships access to docking facilities upriver at Paisley. The present Rolling Lift Barscule bridge crosses over the former canal section of the White Cart. The Clyde/Cart confluence area was later deepened to permit the launching of large ships from what was formerly John Brown shipyards. These various navigation schemes radically changed the topography of the Cart Waters.

The earliest known owner of the ground on which the holy grass grows was Andrew Hay who obtained a Charter for these lands from the Regent Moray in 1568. Andrew Hay was Rector of Renfrew in the Roman Catholic Communion in 1558 but he joined the Reformers and was appointed as Protestant Minister in Renfrew in 1560. He was also Rector of Glasgow University. The estate, then known as Renfield, stayed in the Hay family until it was sold to Colin Campbell of Blythswood in 1654 (Souden, 1927). The estate was renamed Blythswood and stayed with that family until recently. Nothing now remains of Blysthwood House and its once extensive gardens.

Less than a mile upstream on the Black Cart Water is the site of the ancient church of Inchinnan. The first structure on the site dated from between 593-612 A.D. and around 1100 A.D. a stone and lime edifice was erected at the side of the river (McClelland, 1905). A church existed on this site until the 1960's when the building was dismantled and re-located at Inchinnan as part of the development of Glasgow Airport.

EARLY RECORDS OF HOLY GRASS AT RENFREW

Holy grass was found at Blythswood by J. R. Lee on the 28th April 1931. Lee, who was at that time the President of the Glasgow and Andersonian Natural History Society, exhibited the specimen at a meeting of the Society on the 11th May 1931 (Glasgow Naturalist, 1931). A notice later appeared in the Report of the Botanical Society and Exchange Club of 1931 which states " *Savastana odorata (Hierochloe borealis).* A small patch, well established, was found on the bank of the River Cart, Blythswood, Renfrew, J.R. Lee. The old church of Inchinnan is only half a mile away, and Paisley Abbey is five or six miles distant. Mr Lee thinks that the plant can hardly have been there long, for the locality was formerly well-known to local botanists, and suggests that it is a casual introduced with ships' ballast. ——" This appears to be the earliest published account of the holy grass at Renfrew. It is not listed in The *Clydesdale Flora* or in subsequent editions, the fifth and last in 1891 (Hennedy, 1865). Lee's herbarium sheet, now in the Glasgow University Herbarium, records the location as "banks of the Cart at Blythswood" and the plant was named *Hierochloe borealis* Roem. & Schultz. A further specimen collected by him at the same location is dated 19th May 1932. Dr Donald Patton, a fellow member of the Society, collected two specimens from the same area in 1933. These are named *Hierochloe odorata* Wahl. and were collected from the "right bank of Cart below Inchinnan bridge." This is almost certainly the same site discovered by Lee two years earlier.

The late J.H. Penson of Glasgow took a great interest in the holy grass at Blythswood, and between the years 1959 and 1976, he visited the area almost every year. His manuscript notebooks, now in the possession of A. McG. Stirling, give an interesting and informative account of the flowering success and survival of the holy grass during this period. Penson appears to have had knowledge of only two of the three sites known to today's observers. His detailed notes are too extensive to be quoted verbatim. The following extracts may be of interest.

23rd April 1960. "Only 12 flowerheads, less developed and weaker than on the 18th April last year. Not seen in any spot but the one."

16th June 1960. "7 flowerheads, mostly disintegrating, possibly some or all infertile. Site partly covered with rubbish apparently brought up by the tide or brought down by the river."

15th April 1961. "64 flowerheads , all at one spot, perhaps slightly extended."

It appears from the above notes that Penson knew of one site only which was probably the site discovered by John Lee in 1931. In 1969 Penson makes mention of a second station which he identifies as being "c. 700yds nearer the [Inchinnan] bridge, more extensive than first, c. 170 flowerheads, mostly on the edge of the riverbank." Penson also reported that construction work for the Normandy Hotel in 1970 did not seem to affect the new site. His comments about the grass flowers being infertile are interesting. Florets recently collected from the site which were sent to the Rare Plants Project at Kew did not contain viable seeds (K. Watson pers. comm.).

PRESENT STATUS OF HOLY GRASS AT RENFREW

There are three sites presently known (Fig. 2). A thorough search of the banks upriver on both the White and Black Cart Waters was undertaken in late April 1999. No further patches of holy grass were located.

Photographs of holy grass and one of its Renfrew locations are shown on the front cover of this edition. Legends are inside the back cover (Fig. 1).

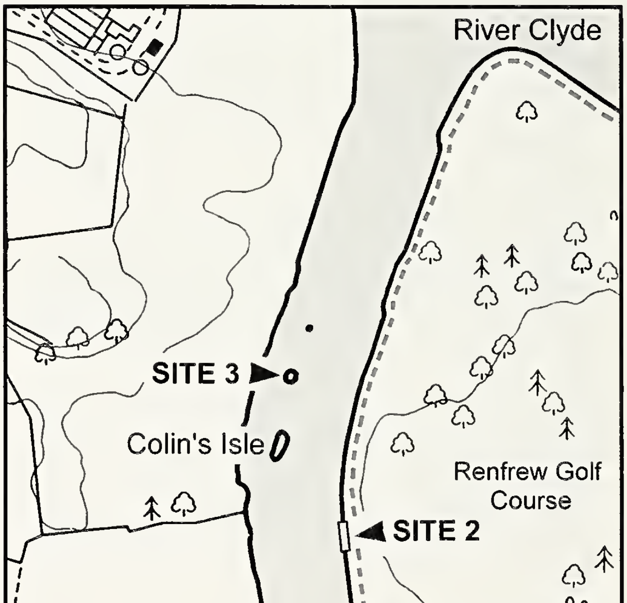

Fig. 1 Map showing holy grass sites on the tidal White & Black Cart River confluence.

Site 1 NS495680 Located at the rear of the Normandy Hotel, this large patch measures 10 metres long by 1 metre wide. This site is to be found on the east bank of the White Cart beginning at the pathside opposite a brick-built enclosure used by the hotel for burning rubbish. The plants extend down-river to a small inlet. In March the lime-green grass blades are conspicuous from the public footpath. In Late April 1999 and 2000 this population produced few flowerheads and seems to thrive vegetatively. This is probably the second station recorded by Penson in 1969.

Site Ecology - The holy grass forms a band at the base of an eroded, sloping bank above the tidal mud. At the edge of the public footpath above are rough grassland plants such as bramble (*Rubus spp.*), common nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), broad-leaved dock (*Rumex obtusifolius*), creeping buttercup (*Ranunculus repens*), ground elder (*Aegopodium podagraria*), coltsfoot (*Tussilago farfara*), false oat grass (*Arrhenatherum elatius*), couch grass (*Elytrigia repens*) etc. On the adjacent tidal mud below are sea aster (*Aster tripolium*), English scurvygrass (*Cochlearia anglica*) and scattered spear-leaved orache (*Atriplex prostrata*). The station is shaded by nearby trees and is well protected from winds.

Site 2 NS495685 Located further down the river, again on the east bank, below the confluence of the White and Black Cart Waters. This site is to be found directly under the flight path of Glasgow Airport. The plants are situated on the riverbank at the pathside across from a large willow at the edge of Renfrew Golf Course. The colony measures 6 metres long by 2 metres wide. In 1999 and 2000 this population produced many flowerheads. The earliest date for flowerheads was 17th March 2000 when four were observed. In April 2000 the surrounding dried grass and debris in the area was s*et a*light by vandals. Half of the holy grass colony was burned but later recovered. This station is believed to be the site discovered by Lee in 1931 and visited later by Penson in the 1960's.

Site Ecology - Grasses dominate the area which include false oat grass (*Arrhenatherum elatius*), and Couch-grass (*Elytrigia repens*). Above are rough grassland species at the edge of the public footpath such as red fescue (*Festuca rubra*), and scattered common nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), and broad-leaved dock (*Rumex obtusifolius*). On the tidal mud below are sea aster (*Aster tripolium*), English scurvygrass (*Cochlearia anglica*), scattered spear-leaved orache (*Atriplex prostrata*) and some greater sea-spurrey (*Spergularia media*). The area is exposed to strong winds which regularly funnel down the rivers and it is fully exposed to sunshine. This station would seem to be much drier than Site 1 due to the exposed situation.

Site 3 NS495688 On the west side of the river, below the Cart Waters confluence, are the remains of a once larger island called Colin's Isle, and now forming a string of three small islands. The larger island, marked as Colin's Isle on O.S. maps, is densely covered by common reed *Phragmites australis.* Holy grass may have originally been on this island but succumbed to competition from the phragmites which spread from the nearby riverbank where it is abundant.. Two small un-named islets lie to the north of Colin's Isle. The first, with a solitary hawthorn tree at the centre, supports a healthy colony of holy grass (Futter, 1992). This patch is about one metre square and flowers were in evidence when visited in May 1999. This islet, accessible only at low tides, is fully exposed to wind and sunshine. It is not known at present when this station was first discovered or by whom. The second and northernmost islet is frequently underwater at high tides and supports only sea aster (*Aster tripolium*).

Site Ecology - The species diversity on this stony, conical island is restricted by its small size. Just above high-water mark is a population of sea aster (*Aster tripolium*). Above this is a scattering of couch-grass (*Elytrigia repens*) merging into a large dense clump of holy grass at the centre of which grows a solitary hawthorn (*Crataegus monogyna*).

Site stability The banking at Site 1 is unprotected and in danger of erosion when the White Cart is in spate or when high tides back upriver. Deposits of rubbish are frequent. The embankment at Site 2 has been artificially re-enforced with stonework at some time in the past and the population does not seem to be in immediate danger from erosion. However, in winter, debris and vegetation washed up by high tides and strong winds regularly pollute the riverbank sometimes blocking the path. In springtime, when the holy grass is beginning to flower, the path is cleared by the District Council and the rubbish is merely tipped over the banking. Some of this rubbish may be deposited onto the site. The small islet, Site 3, does not seem to be affected by the deposition of debris. A stone embankment round the islet seems to protect the site from serious erosion. A further danger to the holy grass populations on the riverbank is the presence of the invasive Japanese knotweed (*Fallopia japonica*), a small colony of which exists between Sites 1 & 2

DISCUSSION

The fact that holy grass is at Renfrew raises the question of how such a rare plant should come to be on the lower reaches of the Cart Waters and why the grass was not discovered until 1931. There would seem to be a number of possibilities - none of which can be substantiated by any facts. The following points may be of interest.

a) The lack of records prior to 1931 may be explained by holy grass being most conspicuous early in the year. It is often overlooked if searched for in summer. During the nineteenth century, access to the site would have been difficult for the Blythswood area was strictly private being part of the policies of Blythswood House. Never the less, Prof Hennedy was known to have botanised around Inchinnan, but the holy grass site was unknown to him and the subsequent compilers of the *Clydesdale Flora* between 1865 - 1891.

b) Lee's suggestion of the plants being introduced from ships' ballast is an interesting hypothesis as a number of 'alien' and unusual plants are to be found on the Cart Water banks, e.g. *Cardaria draba*. However, local botanists do not seem to favour this idea for the origin of the holy grass.

c) The grass may have been grown in a herb garden at the adjacent Blythswood House or the former Renfield House. Garden rubbish could have been dumped into the Cart to be washed down-river.

d) In the immediate vicinity of the holy grass sites there are three long established churches. The present Renfrew Parish church is situated less than a mile east of the Cart Waters. On the White Cart, a few miles upriver, stands Paisley Abbey and on the Black Cart is the site of the former Inchinnan church. The close proximity of the holy grass sites to these early churches invites the assumption that there could be a connection. However, recent studies of plant remains and pollen found in drains at Paisley Abbey did not include holy grass pollen.

Despite the lack of historical and archaeological evidence, the holy grass on the Cart Waters could be a long overlooked relict population surviving from much earlier times when it was grown locally and used, along with other aromatic plants, to freshen the damp, earthen-floored churches in the surrounding area.

ACKNOWLEDGMENTS

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A SURVEY OF THE AQUATIC VEGETATION AND BENTHIC MACROINVERTEBRATES OF THE CRINAN CANAL, WITH PARTICULAR REFERENCE TO THE EFFECTS OF SEAWATER INPUTS

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INTRODUCTION

The 15 km-long Crinan Canal links Ardrishaig and Crinan in Argyll across the northern end of the Kintyre peninsula. The canal was opened in 1801 allowing boat traffic to take a short cut between Loch Fyne and the Sound of Jura, thus avoiding a lengthy voyage around the Mull of Kintyre. Fifteen locks permit boats to ascend and descend the 20 m to the canal summit, which lies between Cairnbaan and Dunardry. Loss of water through the locks is made up from reservoirs in Knapdale Forest to the south. Nowadays the canal is used mainly by pleasure craft.

Summer water shortages are a long-standing problem in the operation of the canal. During dry periods in summer, particularly when boat traffic has been heavy, pressure on water resources has led to draught restrictions and restricted locking for canal users. In order to overcome these problems, British Waterways has for several years pumped saline water from the River Add estuary into the western reach of the canal. A new fixed back-pumping station has recently been installed above Lock 14 at Crinan which automatically pumps water from the estuary into the canal when water levels in the latter drop to a critical point.

The effects of these regular introductions of saline water on the ecology of the freshwater Crinan Canal are unknown. Salinity monitoring carried out by British Waterways in summer 1997 showed that the effects of pumping brackish water from the Add estuary were restricted to the 5 km between Locks 14 and 13 (Halat, 1997). No studies were carried out on the ecological impact of the pumping.

There is little information available on the impact of saline inputs on other British canals. The westernmost section of the Leeds & Liverpool Canal, in Liverpool, formerly received inputs of Mersey estuary water. Here, strong salinity stratification was observed with a saline layer penetrating eastwards along the canal bed in mid-channel, but the water along the margins was much less affected (Dr J.W. Eaton, University of Liverpool, personal communication). Most plant growth (mainly *Ceratophyllum demersum, Myriophyllum spicatum* and the filamentous alga *Cladophora*) was concentrated along the margins and there was little evidence of impact, although these plants have some degree of tolerance of mild brackish conditions anyway (Sculthorpe, 1967). Effects on invertebrates were more substantial with invasion of estuarine species; while barnacles were reported to have established on the canal walls close to the Stanley Dock entrance to the canal (although the evidence suggested that they were unable to reproduce successfully).

In 1999, the Scottish Environment Protection Agency (SEPA) commissioned a survey of the Crinan Canal to assess the effects of the new and historical pumping regimes on the aquatic vegetation and benthic macroinvertebrates of the canal, and to examine the feasibility of using these communities as indicators of the scale and extent of any such impact. The survey also provided an opportunity to assess the overall distributional status of aquatic plants and macroinvertebrates throughout the canal.

METHODS

The entire length of the Crinan Canal was surveyed during 5 - 6 August 1999. The abundance of each aquatic plant species present was recorded per 200 - 250 m stretch of canal (lengths varied slightly owing to the presence of locks, but 64 sites were defined) using an abundance scale of 1 = present; 2 = moderate abundance; 3 = highly abundant. A grapnel on a 10 m length of cord was used to retrieve plants from deep water. Conductivity was recorded at every site using a portable field instrument. In addition, Ekman grab samples of sediment and submerged vegetation were taken at 10 sites to assess benthic macroinvertebrate distribution (Fig. 1). These samples were sorted in the field using a nest of sieves. The more obvious macroinvertebrates were picked out and preserved in 70% alcohol. These specimens and the preserved sample residues were delivered to the SEPA laboratory at East Kilbride for further examination and identification. Water conductivity was recorded at each sampling point, using a field-portable meter.

RESULTS & DISCUSSION

Distribution of aquatic plants

The most striking feature of the distribution of aquatic plants in the canal was the contrast between the stretch of the canal west of Lock 5 at Cairnbaan and the stretch to the east (Fig. 2). For reasons discussed below, the aquatic vegetation in the summit and western reaches was scanty and generally of lower diversity than in the eastern reach. In addition to the higher diversity of aquatic plants generally occurring at sites east of Lock 5, there was a greater overall abundance of individual species. *Sparganium angustifolium* showed this pattern very clearly. Some species such as *Alisma plantago-aquatica*, *Potamogeton praelongus* and *Potamogeton natans* were restricted to the eastern stretch, although others (e.g. *Typha latifolia* and *Nymphaea alba*) showed the opposite distribution. It is possible that these latter two species have been deliberately introduced to the canal as ornamentals in the vicinity of the canalside dwelling 200 m east of Crinan Bridge.

Distribution of macroinvertebrates

At three of the 10 sites sampled by Ekman grab, the substrate was rocky and no macroinvertebrates were collected (Table 1). At most of the remaining sites, both taxon richness and abundance were low. The samples taken near Bellanoch and Oakfield Bridges contained the richest and most abundant fauna. Of the 18 taxa recorded, only the snails *Potamopyrgus jenkinsi* and *Lymnaea peregra*, naidid and tubificid worms and chironomid larvae were found at three sites or more.

The canal as a habitat for aquatic vegetation and macroinvertebrates

Several factors combine to make the Crinan Canal a rather hostile place for aquatic plants, particularly in its summit and western reaches.

First, the canal is heavily used by powered craft, with traffic concentrated during the summer (plant growth) period. Boat traffic probably exceeds the critical range of 2,000 - 4,000 movements ha^{-1} year^{-1}, identified by work elsewhere on the UK canal network, as producing a substantial negative impact on aquatic vegetation (Murphy & Eaton, 1983; Murphy, 1992; Murphy *et al.*, 1995). However, the ecological impacts of boat traffic on the Crinan Canal ecosystem will be reduced, compared with powered craft impacts in most other navigable UK waterways (Murphy *et al.*, 1995), by three factors. These are as follows:

1. The canal is deep and wide. This means that the wave energy and other disturbance effects of a boat moving along the canal are reduced because of the greater volume of water to absorb the disturbance, in comparison with boat effects on canals of smaller cross-sectional area.

2. Most of the craft using the Crinan Canal are sea-going yachts. These have a streamlined and rather small hull cross-section, both of which produce a smaller wake compared with the cabin cruisers and canal barges which use most other UK canals.

3. Much of the canal bed and banks are rocky, either deliberately armoured or simply because the canal has been cut through rock. In addition, regular dredging takes place. The net effect is that there is less sediment in the canal (much less in many reaches) than in typical canals. Resuspension of sediment due to disturbance caused by moving craft is therefore greatly reduced (also because of the other two factors noted above). Silt resuspension, which reduces underwater light availability for plant photosynthesis, is a major cause of growth reduction for submerged plants in most UK canals that are heavily used by powered craft. It does not appear to be a feature of the Crinan Canal.

Second, the rocky and stony substrates which are a prominent feature of the summit and western reaches are inherently unfavourable as a habitat for aquatic plant growth. The 1999 survey showed that aquatic plants in these stretches tended to be limited to sites where local accumulations of silt occurred. These include corners of lock ponds, bays and offside (landward) banks of the canal where armouring was less of a feature. Running alongside the estuary shore, the canal tends to leak to the seaward side, leading to a concentration of armouring along the towpath bank.

Third, the depth and generally steep sides of the canal, coupled with the dark, peat-stained water of the system means that there is very limited room for submerged plant colonization within the photic zone. The photic limit for submerged plants (3% of surface light on average) is probably reached at less than 1 - 2 m in the Crinan Canal, which would make most of the canal bed uncolonizable by submerged plants. Often, much of the limited underwater space suitable for colonization along the sloping banks is occupied by emergent plants or floating-leaved plants such as *Sparganium angustifolium*, which outcompete submerged species. It was very noticeable that submerged plants in the western reach only showed any profusion of growth in the few places where substantial areas of shallower water occurred (notably Bellanoch Bay). Submerged plants were virtually absent from the summit reach, which is basically a long, rocky trench with virtually no suitable places for submerged plants to colonize. Conditions are better in the eastern reach (constructed along a raised beach, with less rocky substrate and more areas of shallow water).

Fig. 1 Map of Crinan Canal showing locations of macroinvertebrate sampling sites.

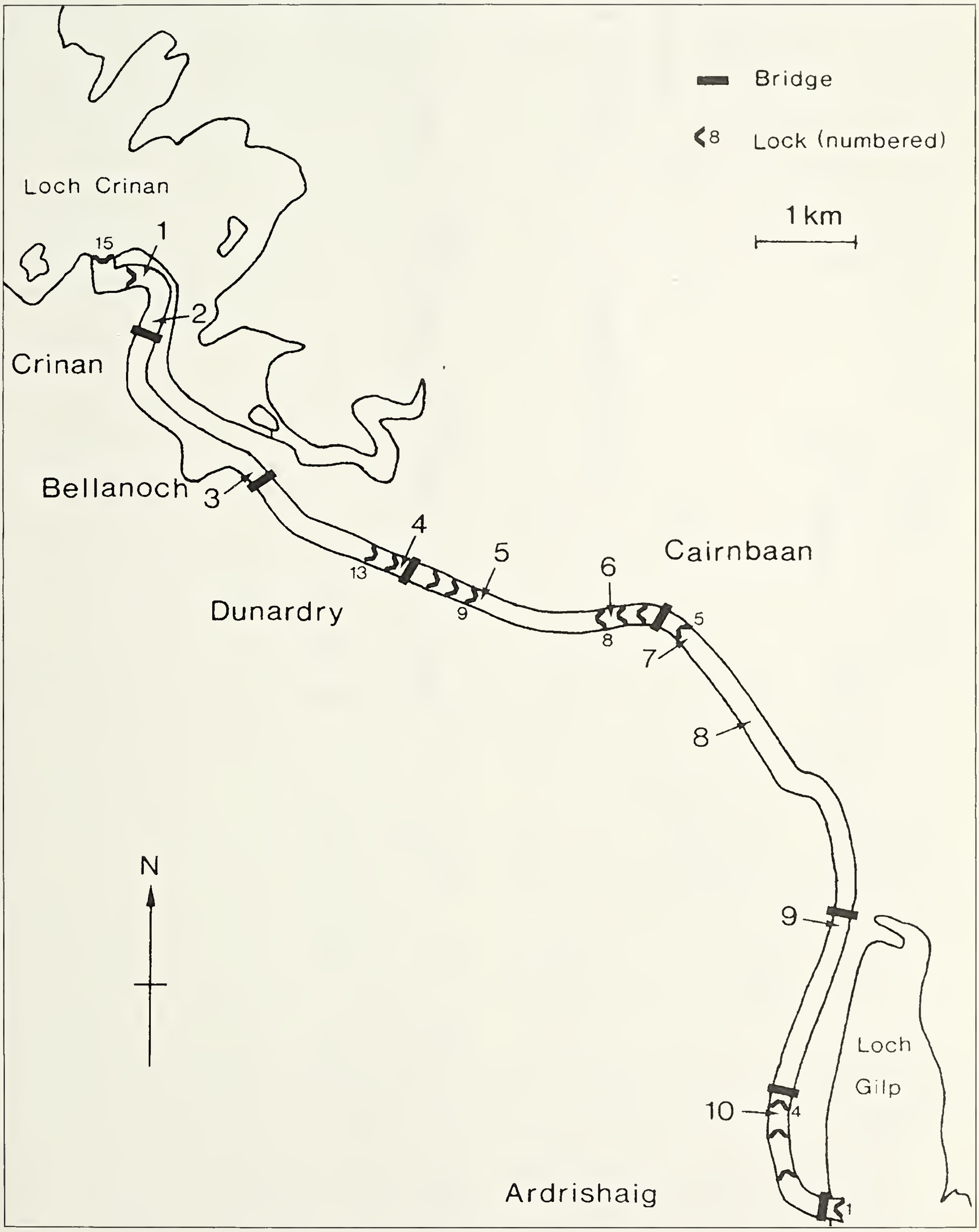

Fig. 2 Distribution of aquatic plants in the Crinan Canal, August 1999.

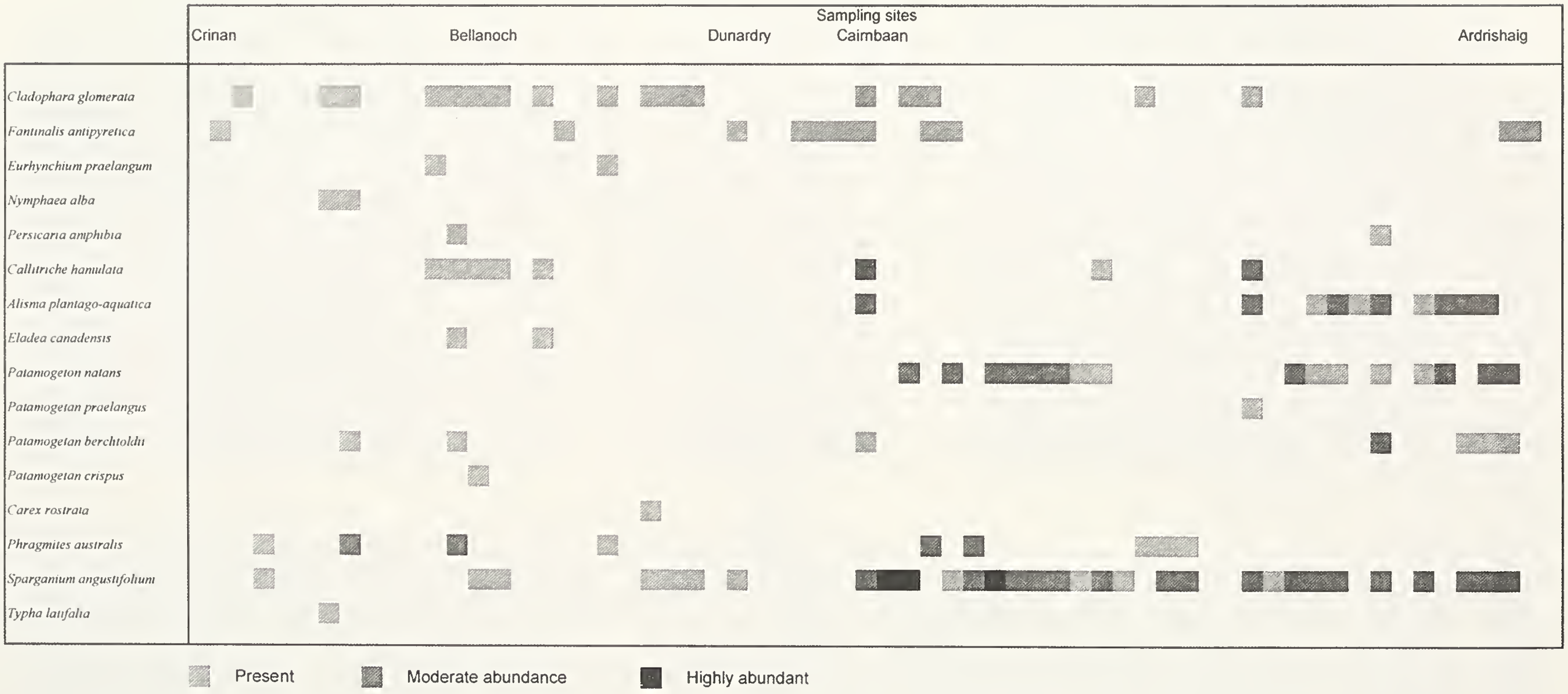

Table 1. Distribution of benthic macroinvertebrates in the Crinan Canal, August 1999 (+ present, ++ frequent, ++ abundant).

	1 NR7909 44	2 NR7949 38	3 NR8049 24	4 NR8209 12	5 NR8239 10	6 NR8349 08	7 NR8409 08	8 NR8488 99	9 NR8578 80	10 NR8518 59
Potamopyrgus jenkinsi		+	+++				+			
Lymnaea peregra		+					+	++		
Planorbis sp.									+++	
Sphaeriidae							+		+++	
Naididae					+			+	+	
Tubificidae					+		+	+	+	+
Lumbriculidae									+	
Helobdella stagnalis								+		
Asellus aquaticus							+	++		
Baetis rhodani			+							
Corixidae (nymphs)								+	+	
Haliplidae (larvae)		+					+			
Sialis lutaria			+							+
Hydroptila sp.			+							
Phryganea bipunctata								+		
Athripsodes cinereus								++		
Ceratopogonidae				+						
Chironomidae			++		+		+	+	+	+

The combined effects of boat traffic disturbance, unsuitability of substrate conditions, and problems of light availability for submerged plants mean that the canal, particularly in its summit and western reaches, is inherently unlikely to support the dense growth and high diversity of aquatic plant species which are characteristic of lowland Scottish canals (e.g. Ross *et al.*, 1986; Anderson & Murphy, 1987; Murphy *et al.*, 1987; Watson & Murphy, 1988). Particularly in its summit and western reaches, the canal ecosystem is already experiencing a fairly strong combination of disturbance (ecologically defined as any factor which damages plant tissue, e.g. boat waves in a canal system) and stress (any factor which limits plant photosynthesis, e.g. light limitation or presence of toxic ions such as salt in a freshwater system). Plants are quite good at resisting the effects of either increased disturbance or high stress intensities. Typically the plant assemblage present shifts to accommodate the new conditions by colonization of species best able to tolerate either disturbance or stress. However, plant communities are usually unable to tolerate a simultaneous combination of high stress and high disturbance (Dickinson & Murphy, 1998). In practice, what this means for a system like the Crinan Canal is that its aquatic vegetation is already living rather close to the edge of what is surviveable by plants. Increasing the intensity either of stress-causing conditions, or of disturbance, is consequently quite likely to have a major effect on the vegetation, leading to loss of plant cover and diversity from the system.

Adding a further stressor to the system in the form of saline water intrusion from back-pumping above Lock 14 is likely to increase the intensity of stress experienced by freshwater plants. If the scale (both frequency and quantity of seawater entering the system are important) of the back-pumping is great enough, freshwater species present are likely to be lost.

The probability of loss of individual species depends on how susceptible the plants are to saline stress, and also on their growth form. In general, plants with their foliage at or above the water surface are less susceptible to salinity-associated damage than plants with their vulnerable leaf tissue below the surface. *Phragmites australis* for example is quite tolerant of brackish conditions. *Nymphaea alba* and *Sparganium angustifolium* are less so, while none of the submerged species currently found in the canal have any significant salinity tolerance (Sculthorpe, 1967).

Some of the same features of the canal which limit the abundance and diversity of aquatic plants (e.g. the rocky bed in the western half of the canal and the regular dredging) also conspire to make the canal a relatively inhospitable environment for benthic macroinvertebrates. The reduced habitat diversity resulting from the scarcity of aquatic vegetation in large parts of the canal also partly explains the relatively impoverished macroinvertebrate fauna. Representatives of 18 macroinvertebrate families were found during this survey, compared with 43 families recorded in the Forth & Clyde Canal during summer 1980 (SEPA unpublished data).

The high variability between sites in the richness and abundance of the macroinvertebrate fauna undoubtedly reflects the limited and patchy distribution of soft sediments. The grab sampling method used would not have been effective where the canal bed was rocky or covered with only a thin layer of soft sediments. The absence or scarcity of certain groups such as water beetles, dragonflies and hemipteran bugs can be attributed to the sampling method used. It is highly probable that sweep sampling of the canal margins using a long-handled pond net, particularly in the more well-vegetated areas, would have increased the taxon list considerably.

Possible impact of seawater back-pumping

In 1999, both *Sparganium angustifolium* and *Phragmites australis* occurred in a side basin of the canal some 400 m above the back-pumping discharge. *Nymphaea alba* occurred some 200 m east of Crinan Bridge, about 1 km above the discharge. No submerged vascular plants were found closer than 1.2 km above the discharge (*Potamogeton berchtoldii*, 400 m east of Crinan Bridge). One unhealthy-looking clump of the aquatic moss *Fontinalis antipyretica*, and isolated fragments of green filamentous algae (*Cladophora*) were the only submerged plants found anywhere in the westernmost kilometre of the canal. The sediment in this stretch was very black and anoxic, probably as a result of the decomposition of leaf litter: the landward bank of the canal here is heavily wooded. The only macroinvertebrate species found in grab samples taken from west of Crinan Bridge was a single specimen of the snail *Potamopyrgus jenkinsi*, a euryhaline species which in Scotland spread from brackish to fresh waters during the first half of the 20th century (Hunter & Warwick, 1957).

It should be borne in mind that the extreme western end of the Crinan Canal is already inherently a poor place for aquatic plant growth (especially submerged plants). However, it is quite likely that back-pumping has made growth conditions in the canal more difficult for these plants. The presence of the highly-visible floating plants (*Sparganium angustifolium* in the bay 400 m east of the pump discharge and Nymphaea alba in the bay adjacent to the canalside dwelling some 200 m east of Crinan Bridge, with a second population occurring a further 200 m east) may provide convenient markers of possible future changes associated with back-pumping. Should either population show substantial damage or loss in the absence of other likely causes of damage, this could be an indication of increased salinity impact on the system.

At present there is no indication of any damage which might be associated with back-pumping above a point about 400 m east of Crinan Bridge (i.e. about 1.2 km above the pump discharge). Bellanoch Bay (1.4 km east of Crinan Bridge and about 2.2 km above the pump discharge) has a diverse and, for the Crinan Canal, abundant community of aquatic plants, including three submerged species. Potentially the whole of the western stretch below Lock 13 is at risk, since saline water would reach as far east as this lock. The grab sample taken from this stretch just west of Bellanoch Bridge had the second highest macroinvertebrate taxon richness and abundance of those collected from the canal, although the sample was heavily dominated by the salt-tolerant snail *Potamopyrgus jenkinsi*. More intensive sampling of this stretch using other methods (e.g. sweep netting) would be required to more clearly establish if the saline discharge were having a significant effect on the macroinvertebrate fauna.

The limited evidence of a conductivity survey undertaken during 5 - 6 August 1999 (when no back-pumping was taking place) suggests that no enhancement of conductivity was present at this time further east than Bellanoch Bay. Both of the sea lock ponds at the two ends of the canal had strongly brackish water with 4 - 5 mS cm^{-1} conductivity. In contrast, conductivity in most of the canal (from above Lock 1 to Bellanoch Bay) was in the range 0.1 - 0.2 mS cm^{-1}. The stretch from Bellanoch Bay to Lock 14 showed a conductivity up to three times higher than the rest of the canal, peaking at around 0.3 mS cm^{-1} west of Crinan Bridge. While this is still a low value in absolute terms, it provides evidence for a residual effect most likely to have been produced by previous back-pumping of seawater into this stretch.

If seawater is indeed responsible for a loss of submerged freshwater plants from the westernmost kilometre of the canal, it is an interesting question as to whether in the longer term there may be a colonization of this currently empty habitat by plant species tolerant of fluctuating salinity conditions. Since the pumping (and even more so automatic pumping by the permanent installation) is a recent development, and colonization by new species takes time, it is unsurprising that nothing as yet has successfully invaded. However, there are several plants which may do so. Prime candidates are *Potamogeton pectinatus* and *Ruppia maritima*, both of which can tolerate elevated salinity. The latter is an estuarine species, the former less tolerant of constant brackish conditions, but well adapted to a habitat in which brackish and freshwater conditions alternate on a regular basis. Both plants are common around the Scottish seaboard and may successfully colonize watercourses influenced by engineering operations (e.g. weir construction) which alter the balance of freshwater-to-saline conditions in rivers and other coastal watercourses (e.g. the Wick River, Caithness: Murphy, 1993). It remains to be seen whether the combination of other, non-saline stress and disturbance conditions occurring in this stretch of the Crinan Canal would be too great to allow such saline stress-tolerant plants to successfully colonize.

CONCLUSIONS

In August 1999, an end-to-end survey of the Crinan Canal recorded 16 species of aquatic plants present, including one filamentous alga and two aquatic moss species. In addition, 18 macroinvertebrate taxa were collected.

The aquatic flora of the canal was dominated by floating-leaved rooted species, particularly *Sparganium angustifolium*. The emergent *Phragmites australis* was also widespread. Restricted distributions were shown by two other dominant species: emergent *Alisma plantago-aquatica* and floating-leaved rooted *Potamogeton natans*, occurring only in the eastern stretch between Locks 1 and 5. Submerged plants were much less abundant, especially in the summit and western stretches, and were completely absent from the westernmost 1.2 km of the canal.

There was evidence that water quality in this westernmost stretch was being impacted by seawater back-pumping. Although no pumping appeared to be going on at the time of sampling (overflow weirs were running, suggesting that water was not in short supply) there was elevated conductivity in this stretch, suggesting a residual effect of earlier pumping. Recorded conductivities were never higher than 2 - 3 times the average of 0.13 mS cm^{-1} for the rest of the canal. In contrast, values of >4.0 mS cm^{-1} were recorded on the landward sides of Locks 2 and 15 which are regularly influenced by seawater inflow when the sea locks are used.

The impact of back-pumping on aquatic vegetation of the westernmost stretch of the Crinan Canal is measurable but limited. This stretch of canal is already a hostile environment for aquatic vegetation owing to its physical characteristics. However, the complete absence of submerged vascular plants (and virtual absence of filamentous algae or mosses) up to 1.2 km east of Lock 15 may be a consequence of the seawater incursions produced by back-pumping when water levels are reduced.

The presence of some floating-leaved rooted vegetation and emergent plants at two locations within this stretch suggests that the impact to date has not been excessive, and these conspicuous stands of vegetation (especially *Nymphaea alba*) might provide a useful and easily-monitored marker for future impact. If they show signs of damage or disappear, this could indicate enhanced saline impact in the vulnerable stretch of canal.

The benthic macroinvertebrate fauna at most sites was relatively impoverished, reflecting the lack of soft sediments and the limitations of the sampling method used. The results were therefore inconclusive. Further investigations would be required to ascertain whether seawater back pumping was having a significant impact on the macroinvertebrate community west of Lock 13.

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TRACING THE ELUSIVE *HOLOPEDIUM GIBBERUM* IN THE PLANKTON OF LOCH NESS

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INTRODUCTION

Loch Ness is the largest single volume of freshwater in the British Isles (~ 7.5 million m^3) occupying a simple trench like basin 39 km long and 1.5 km wide. The steep shelving sides plunge to a maximum basin depth of 230 m and a mean depth of 132 m. The loch provides a useful reference as an undisturbed system because of its remote location and the relative lack of anthropogenic influence on the basin and its catchments. Considerable information has been compiled by the Loch Ness and Morar Project under the auspices of A. Shine and published in a volume of The Scottish Naturalist (1993). Freshwater ecologists from Lancaster University have been studying the loch for almost 10 years, initially characterising the microbial ecology of the loch and then focusing on the importance of allochthonous sources of carbon (derived from the catchment) as a subsidy to the production within the loch itself (Jones *et al.*, 1995, 1996, 1997, 1998; Laybourn-Parry *et al.*, 1994; Young *et al.*, 1995). Various aspects of the pelagic food web have now also been studied at the higher trophic levels including the fish species (Grey *et al.*, 2000a, b, Thackeray *et al.*, 2000).

Understanding the ecological role of crustacean zooplankton is fundamental to lake food web processes since the zooplankton links the microbial production to the fish. This article concerns the exclusively planktonic ctenopod ('comb-footed') *Holopedium gibberum* Zaddach. *Holopedium* is a relatively large species (mature specimens are 1.5 – 2.5 mm) which exhibits a strong preference for oligotrophic lakes with a low calcium content and drifts, or swims, supported by a gelatinous mantle (Scourfield & Harding, 1966). Gut content analysis of brown trout (*Salmo trutta*) provided by anglers from Loch Ness revealed little evidence of ingestion of Holopedium (Thackeray *et al.*, 2000). Thus, the apparent paradox of *Holopedium* occurring during the summer months with comparable abundance to other zooplankton species in the water column, yet rarely occurring in the diet of the planktivorous fish prompted a more detailed assessment of the ecology of this species in Loch Ness.

METHODS

Sampling was conducted monthly from a fixed station above a 200 m water column, from the northern end of Loch Ness. To investigate the water column structure, temperature readings at 5 m intervals from the surface to a depth of 50 m were recorded using a YellowStone Instruments probe, and the profiles plotted (Fig. 1). Plankton samples were also collected from the fixed station. Some horizontal variability in plankton distribution can develop in Loch Ness, mainly due to wind action (Jones *et al.*, 1995) but this does not seriously affect results from the fixed sampling station (Jones *et al.*, 1997). A 0.35 m diameter net of mesh size 110 (m was deployed taking three vertical hauls from 30 m to the surface and each sample was immediately preserved in 70 % industrial methylated spirit (IMS). Aliquots were examined in a Bogorov counting chamber using a Leica stereozoom microscope, the zooplankton identified to species level and mean abundance from the three replicate hauls calculated. Seasonal abundance patterns of individual zooplankton species were compared using regression analysis.

RESULTS

The water column temperature regime of Loch Ness was typical of a warm monomictic lake; a single period of free circulation per year, with consequent disruption of the thermocline. The water column was also relatively stable as one might expect from such a large volume of water ensuring only slow heat gain during spring (Fig. 1). Onset of stratification was delayed until June as a consequence of the colder waters and the prevailing south westerly winds blowing along the axis of the loch. The water column began to destabilise by late September.

The pelagic zooplankton from Loch Ness showed seasonal variation in both abundance and community composition, but was typically dominated by copepods (Fig. 2a). *Eudiaptomus gracilis* and *Cyclops abyssorum* and their associated naupliar juvenile stages were most abundant early in the year, peaking in May-June. Their combined abundance was >4 individuals per litre in early May. The cladocerans were generally less abundant (Fig. 2b), with *Bosmina coregoni* apparent in the water column throughout the year (0.05 – 0.1

individuals per litre), *Holopedium gibberum* appearing in May, peaking in July (<0.02 individuals per litre) and below detection from late September, and *Daphnia hyalina* dominating in late September and October. The large, predatory cladocerans, *Bythotrephes longimanus* and *Leptodora kindtii* both exhibited relatively short peaks of abundance around July, whilst *Polyphemus pediculus* attained highest numbers in September (Fig. 2c). The predators were comparatively rare, for the most part <0.01 per litre, but because of their larger size contributed substantially to zooplankton biomass during late summer (Grey *et al.*, 2000b). The abundance patterns of *Bythotrephes* and *Holopedium* were remarkably similar (r2 = 0.8; p = <0.01).

DISCUSSION

During the period of study, *Holopedium gibberum* was recorded in the water column of Loch Ness for approximately 4 – 5 months of the year at relatively low abundance (< 0.02 individuals per litre) compared to other grazing species comprising the pelagic zooplankton community. The patterns of abundance were consistent with those reported for Loch Ness by Maitland *et al.* (1981) from 1977-78. Zooplankton communities in oligotrophic lakes are usually dominated by the copepods, or by large cladocerans (Cyr, 1997). In Loch Ness, numerical dominance was associated with the copepods early in the season, but biomass dominance was attained by the cladocerans in late summer primarily due to the presence of the larger predatory species. The phytoplankton community of Loch Ness is typically dominated by large siliceous diatoms comprising *Asterionella* and *Aulacoseira* spp., whilst cryptomonad and rhodomonad flagellates become more abundant later in the summer when the water column is generally more structured (Jones *et al.* 1996; Jones unpublished data). Heterotrophic flagellates and bacterial production also tend to peak in late July – August (Laybourn-Parry & Walton, 1998). *Holopedium* are filter-feeders and most efficient at grazing on planktonic particles < 35 um in diameter (Cyr, 1997; Cyr & Curtis, 1999). Their appearance in the water column thus coincides with peaks in abundance of their putative prey, the smaller algae and bacterial flocs.

The mucopolysaccharide mantle of *Holopedium gibberum* may be well adapted to a life of drifting in the pelagic and indeed offer some defence against smaller predators (O'Brien *et al.*, 1979; Fryer, 1991; Lampert & Sommer, 1997) but must reduce survival against larger predators such as the planktivorous fish or indeed other predatory cladocerans. The mantle hinders escape mobility and the larger body size within increases the chance of visual detection due to the transparency of the mantle. The inherent contrast of a zooplankter is the key property determining how conspicuous the zooplankter is to a planktivore (Eggers, 1977). The seasonal abundance of *Bythotrephes* was closely correlated with that of Holopedium in Loch Ness, suggestive of a strong predator : prey relationship. *Bythotrephes longimanus* is known to prey upon smaller individuals of *Holopedium* and can alter the size structure of the zooplankton community by increasing the relative abundance of larger bodied *Holopedium* in experimental mesocosms (Wahlström & Westman, 1999).

However, if predation pressure from cladocerans results in an increase in *Holopedium* body size, the converse is true of fish planktivores. In a study of Laurentian Shield lakes, Rodriguez *et al.* (1993) described size selective predation pressure by brook trout (*Salvelinus fontinalis*) which reduced the abundance of *Holopedium* of >1.2 mm body length by 76 – 81 %. Similarly, removal of Arctic charr (*Salvelinus alpinus*) from Lake Takvatn in north Norway resulted in an increase in density and biomass of *Holopedium* (Dahlhansen, 1995). The distinct paucity of potential prey in the pelagic zone in Loch Ness induces the planktivorous fish - Arctic charr and to a lesser extent three-spine sticklebacks (*Gasterosteus aculeatus*) and brown trout to be trophically opportunistic. One might therefore hypothesise that a relatively large and immobile prey 'package' of *Holopedium* should be actively selected, compared to the more abundant but smaller and agile copepod species. Thackeray *et al.* (2000) quantified the degree of feeding selectivity exhibited by brown trout in Loch Ness using a selectivity index (Ivlev, 1961). Despite *Holopedium* occurring in comparable numbers to *Bythotrephes* in the water column, the results of gut content analyses showed negative selection, or avoidance of *Holopedium* by brown trout, whilst *Bythotrephes* was actively selected. Arctic charr from Loch Ness exhibited a similar trait (Martin & Shine, 1993) and comparable results were observed in studies on similar fish species in oligotrophic lakes in Canada and Scandinavia (Coulas *et al.*, 1998; Dervo *et al.*, 1991; Hegge *et al.*, 1993). The lack of evidence for ingested *Holopedium* appearing in the gut may be a function of the fragility of the organism. *Daphnia* species and the copepods have robust carapace structures which are readily identifiable in gut content analysis, whilst *Bythotrephes* has a long caudal spine that proves a most recalcitrant indicator of abundance. The protective mantle replaces the need for a robust carapace structure in *Holopedium* and the body may thus succumb to the mechanical pressures of ingestion. Since four independent observers were unable to find significant traces of *Holopedium* in the gut contents of three planktivore species from Loch Ness, it is unlikely that the disparity is due to observer error. Unless the zooplankters have only just reached the gut, observers may be unable to accurately assess the contribution of *Holopedium* to the diet. Alternatively, the mucopolysaccharide mantle may increase the likelihood of fish regurgitating recently ingested prey

Figure 1. Isothermal plot of the top 50 metres of the Loch Ness water column during 1998.

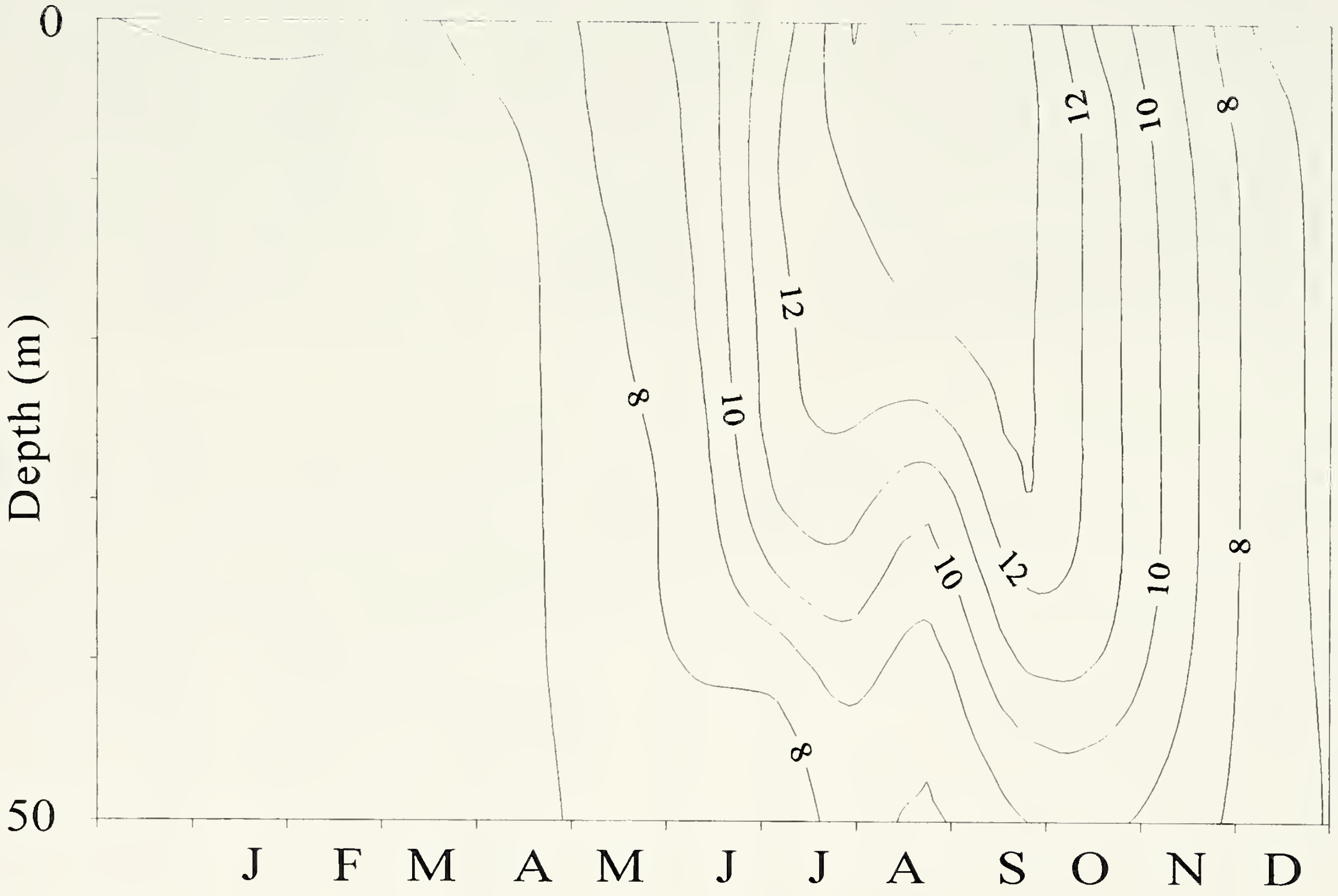
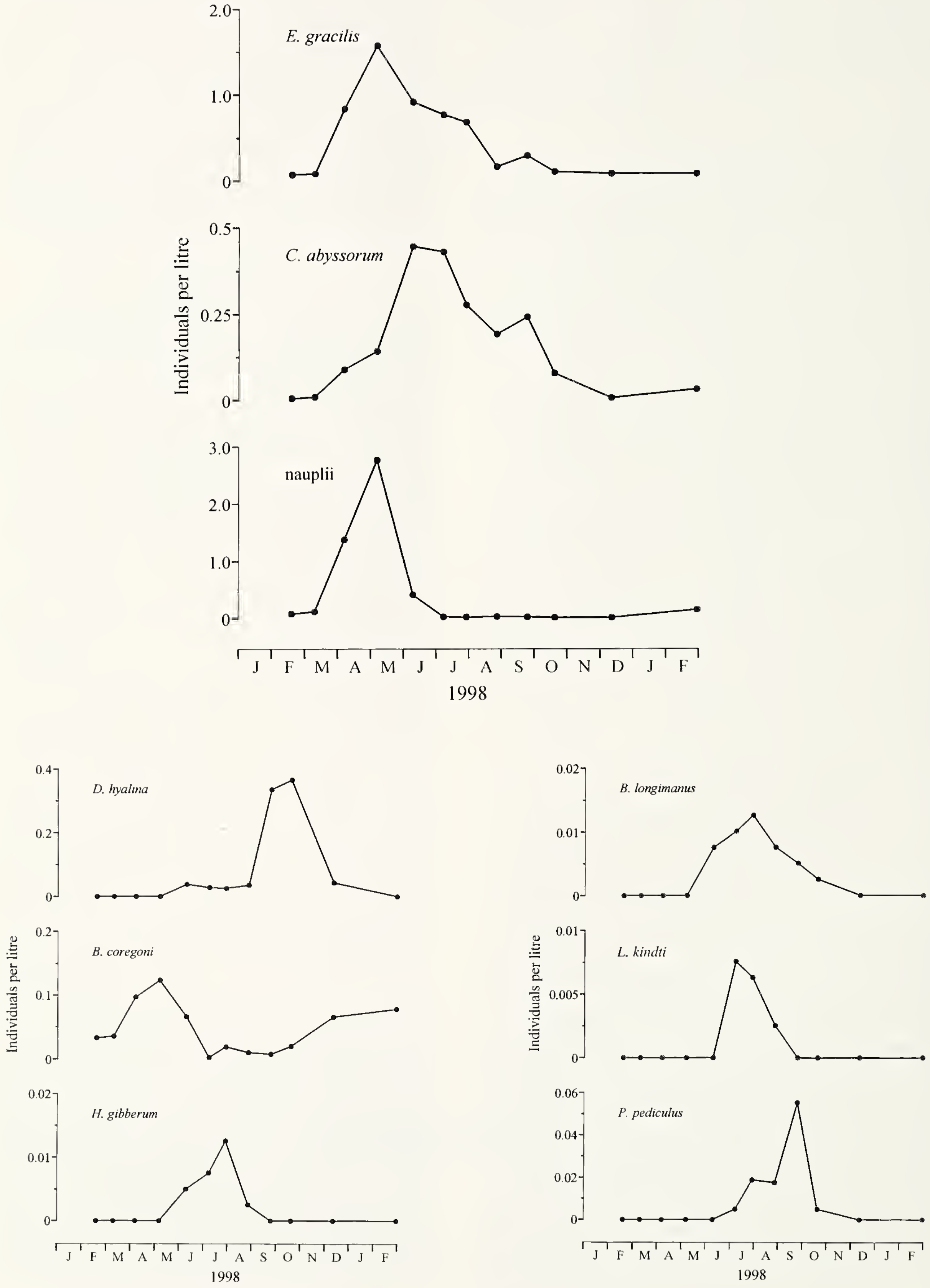


Figure 2. Seasonal abundance (zooplankton per litre) of (a) copepods - top middle , (b) grazing cladocerans - lower left, and (c) predatory cladocerans from the top 30 metres of the Loch Ness water column during 1998 - lower right.



under the stress of capture of the fish although this is purely speculative.

Stable isotope analysis (SIA) is proving a powerful tool to ecologists investigating trophic relationships as it more accurately assesses the long term assimilated diet of an organism. The technique relies on tracing ratios of naturally occurring isotopes (usually carbon and nitrogen 'signatures') from one organism to another because the transfer between each trophic level is predictable (Hobson, 1999). However, to effectively utilise the SIA technique, the source end-points must be robust and significantly distinct from each other. Since *Daphnia* and *Holopedium* have very similar modes of feeding and both are apparently grazing the late summer algal production, they both exhibit similar isotopic signatures (Grey *et al.*, 2000a). Therefore, from the seasonality of the plankton dynamics and from the isotopic evidence, it appears that *Holopedium* is an important consumer of autochthonous production in Loch Ness during the late summer. However, despite detailed gut content and stable isotope analyses, the contribution of *Holopedium* to the diet of planktivores and hence the importance of this zooplankter as a link to higher trophic levels in the Loch Ness food web remains something of a mystery.

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ALLIS SHAD, *ALOSA ALOSA* (L.), IN SHETLAND WATERS

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The allis shad, *Alosa alosa* (L.) is one of the rarest fish in British waters. Throughout the range of the species its populations and those of the other species of anadromous (migrating up rivers to breed) shad in western European waters, the twaite shad, *Alosa fallax* (Lacepède), have been in decline since at least the middle of the nineteenth century. Both species are now classified as rare and are listed in the *Bern Convention* (Appendix III) and in the *EC Directive on Conservation of Natural Habitats and of Wild Fauna and Flora* (Annexes II and V). In Britain the allis shad is protected under the *Wildlife and Countryside Act 1981.* [The species was added to Schedule 5 in 1991 making it an offence to act intentionally to kill, injure or take allis shad. In 1998 it was granted further protection under Section 9.4a, making it an offence to damage, destroy, or obstruct access to, its spawning grounds (Boon, 1994; Vincent Fleming, *pers. comm.*).] Together with the twaite shad it is one of the species assigned high priority in the Environment Agency's project on Species Management in Aquatic Habitats (Aprahamian *et al.*, 1998). The decline in shad populations has been due largely to physical (weirs and dams) or chemical (pollution plugs) obstructions to their up-stream migration to spawning sites and deterioration in water quality in, or damage (siltation and abstraction) to, the freshwater spawning and nursery areas (Aprahamian & Aprahamian, 1990; Aprahamian *et al.*, 1998; Carstairs, 2000; Lelek, 1987; Maitland, 1994; Potts & Swaby, 1991; 1993). Potts & Swaby (1993), in a review of the literature relating to 22 English estuaries, noted recent records of allis shad in only six. There are no longer any spawning sites that can be positively identified in Britain (Aprahamian *et al.*, 1998; Maitland & Campbell, 1992), although the fairly regular capture of mature and spent adults, albeit in small numbers, in the Solway Firth has led to speculation that there are spawning beds in the River Solway or its tributaries (Maitland & Lyle, 1990).

The allis shad occurs along the eastern-Atlantic seaboard from Norway to North Africa (approximately 20°N), and also in the western Mediterranean (Whitehead, 1984; 1985). The northern limit of its range in the Atlantic is unclear from the recent literature. Lelek (1987) and Wheeler (1969; 1978) indicated that it occurs along the Norwegian coast as far north as 70°N, whilst Whitehead (1985: 195) stated that it occurs only as far north as Bergen (approximately 60°N). Its northern limit in British waters is similarly uncertain. Wheeler (1969) indicated that the species occurs all round the British Isles, including the Shetland Isles, and that, although it is nowhere common, it is particularly rare in the northern part of the range. In a later book, Wheeler (1978) again included the Shetland Islands within the geographical range of the allis shad. Maitland (1972) included no records north of approximately 57°N, although in a later popular work (Maitland, 1977) he included a map that showed the distribution of allis shad as extending around the entire coastline of mainland Britain, but not around the Shetland Islands. More recent authors, such as Lelek (1987), Maitland & Campbell (1992) and Whitehead (1984; 1985), included distribution maps which show the species' northern limit on the west coast as being the Clyde and that in the North Sea as approximately level with Aberdeen. Lelek (1987: 60) stated explicitly that: 'It is absent from northern Scotland.' Potts & Swaby (1991) review allis shad distribution in British waters, based largely on published sources, revealing numerous records from all around the coast of mainland Britain, including the north of Scotland and the Western Isles, although their study did not include the Shetland Isles. Although all these recent authoritative works suggest that allis shad do not occur in the waters around Shetland (60° 51'N – 59° 30'N, 00° 40'N – 02° 07'W) there are in fact a number of previous published records from the area dating back to at least the late 1950s. Since 1909 the Marine Laboratory, Aberdeen (now the Scottish Office Agriculture, Environment and Fisheries Department, Marine Laboratory) has kept records of reports of rare species in Scottish waters (Rae & Lamont, 1952). From 1951 to the mid-1980s the records were published in a series of roughly annual papers, initially in *Scottish Naturalist* (records for 1951–1961) and later in *Annales Biologiques* (records for c. 1962–1984). Several of the early lists were not noted by the *Zoological Record* and consequently the records they contain have escaped the attention of subsequent authors. However, they are noted in the Rare British Marine Fishes database, formerly maintained by the Marine Biological Association, and now in the care of the Marine and Estuarine Fish Advisory Service (see Swaby & Potts, 1990 for details of the database). Since 1984 the Marine Laboratory has maintained a computerised database of records of rare species in Scottish waters. This database contains one additional record record of *A. alosa*

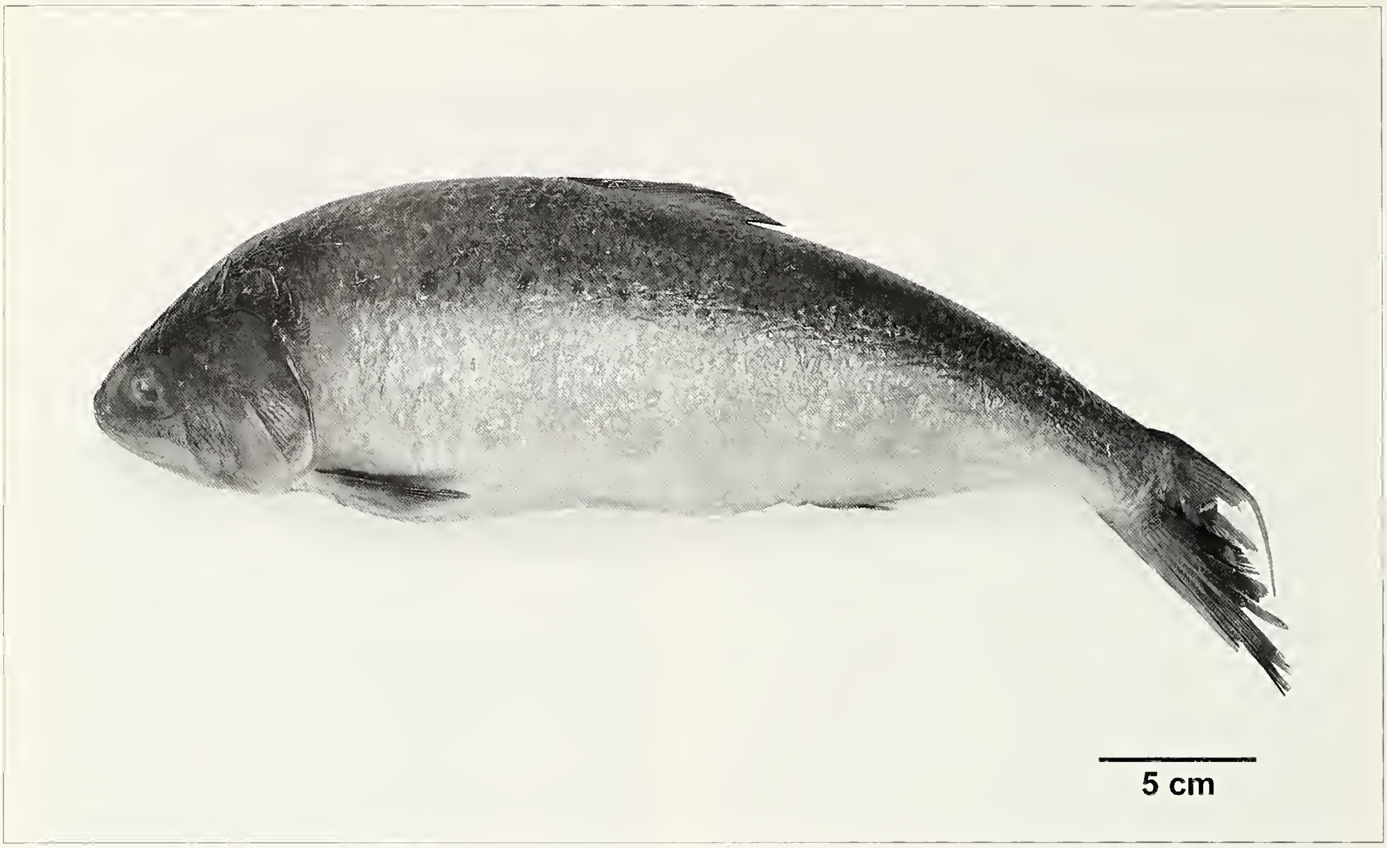

Fig. 1

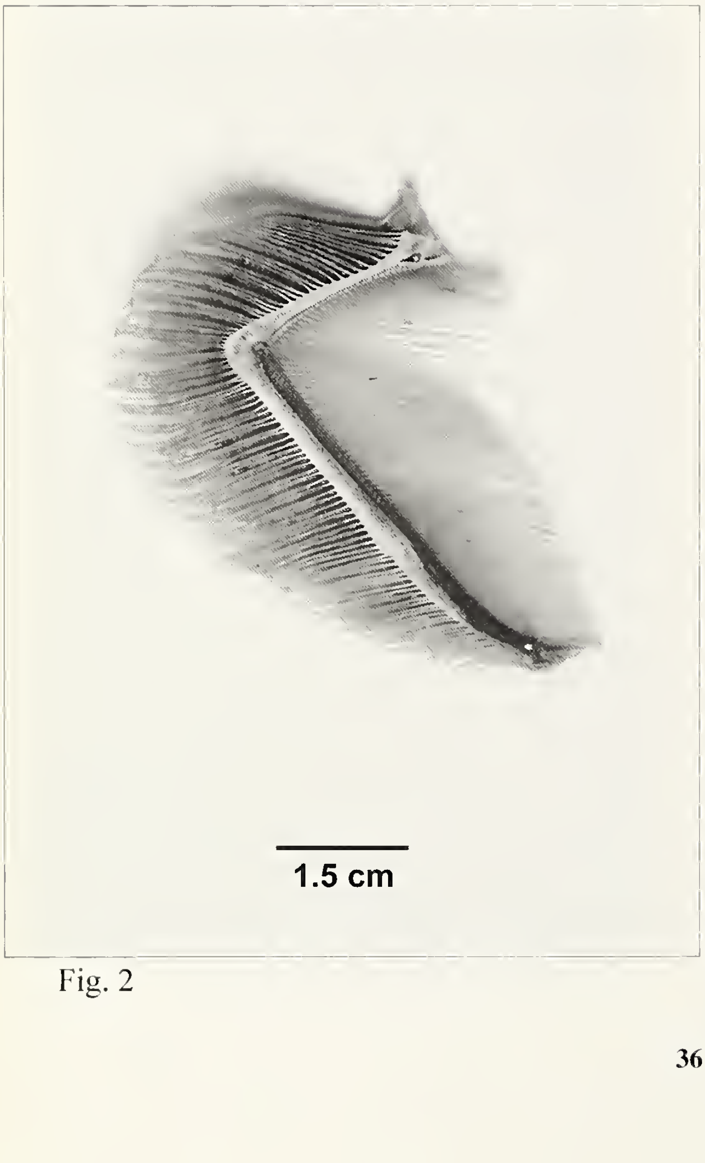

Fig. 2

Fig. 1 *Alosa alosa*, NMSZ 2000.54 caught off Sumburgh Head, Shetland

Fig. 2 Right first gill arch of *Alosa alosa*, NMSZ 2000.54

Table 1. Records of *Alosa alosa* from off Shetland.

August 1959	off Sumburgh Head	♀	Rae & Lamont, 1962
September 1965	off Lerwick	-	Rae & Pirie, 1967
March 1971	Scalloway Deeps	♀	Wheeler *et al.*, 1975
March 1971	Shetland	-	Jones & Pirie, 1973
February 1972	off Bressay	-	Jones & Pirie, 1974
March 1972	off Bard Head	-	Jones & Pirie, 1974
May 1972	St Magnus Bay	-	Jones & Pirie, 1974
March 1975	North of Foula	-	Pirie, 1977
November 1996	61° 00' – 61° 30'N, 02° 00' – 03° 00'W	♂	Gordon Henderson, *pers. comm.*
July 1998	off Sumburgh Head	♂/-/-	Present study

from the vicinity of Shetland, a mature male caught in November 1996 within ICES Statistical Rectangle 51E7 (61° 00' – 61° 30'N, 02° 00' – 03° 00'W) (Henderson, *pers. comm.*). The records of *A. alosa* from off Shetland are given in Table 1.

The present specimen, 340 mm standard length (Ls), was caught in July 1998 by the M.V. *Sunbeam*, skipper John Garrick, approximately 15 miles east of Sumburgh Head, Mainland, Shetland Islands. It was caught in a rock-hopper trawl, at a depth of 67–70 fathoms (122–128 m.), among a mixed haul of cod, *Gadus morhua* L., whiting, *Merlangius merlangus* (L.), and haddock, *Melanogrammus aeglefinus* (L.). The skipper reports that the haul contained three similar fish. As he did not recognise them he retained one for identification; the other two were returned alive to the water (J. Garrick, pers. comm. to JSB). The capture of multiple specimens of *A. alosa* in a single haul in British seas is somewhat unusual and might suggest that allis shad were aggregating in this region off Sumburgh Head.

The retained specimen is registered in the National Museums of Scotland as NMSZ 2000.54. In its patterning it resembles a twaite shad. There is a large dark spot immediately behind the upper part of the operculum and this is followed by a series of dark spots extending along the body to a point approximately level with the middle of the anal fin (Fig. 1). There are about a dozen spots all. On the left side of the fish they are in a straight line but on the right the fourth, seventh and tenth spots are displaced somewhat ventrally. The anterior nine are more discrete than the more posterior spots, which gradually become indistinguishable from the more diffuse dark speckling which occurs in this portion of the body. Most authors report *A. alosa* as having only a single post-opercular spot or at most three spots, compared with five or more in *A. fallax* (e.g. see Baucot & Pras, 1980; Lelek, 1987; Maitland, 1972; Wheeler, 1969; 1975; 1978; 1998; Whitehead, 1984; 1985), although Carstairs (2000) suggests that removal of scales from the flanks of allis shad reveals additional spots. The presence in the present specimen of a total of 107 gill-rakers on the first gill arch (Fig. 2), the longest 147% that of the longest gill-filament (counts and measurements made on gill arch excised from right side), and 87 lateral scale-pockets confirm its identity as *A. alosa*. In *A. fallax* there are fewer than 60 gill-rakers, the longest approximately the same length as the longest gill-filament, and there are fewer than 70 lateral scales.

Although in terms of its gross morphology the specimen is in generally good condition, its storage for over a year in a domestic freezer has resulted in considerable deterioration of the internal organs. The specimen has lost most of its scales, which may account for multiple spots being visible along the body. The gonads have the gross appearance of being testes. They are thin blade-like structures of a non-granular appearance and a reddish-brown colour (after fixation in 4% formaldehyde). Histological examination confirmed them to be testes but the poor state of preservation prevented more detailed conclusions about the fish's reproductive status.

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NOTES ON COPEPOD PARASITES OF PHYLLODOCID POLYCHAETE WORMS IN SCOTTISH WATERS; INCLUDING THE FIRST UK RECORDS OF THE MEDITERRANEAN COPEPOD *Phyllodicola petiti* (Delamare-Deboutteville & Laubier, 1960)

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INTRODUCTION

Many parasitic copepods have grossly modified morphology. In some the body is reduced to a simple sack with, at most, minute vestigial appendages and, in egg-bearing (ovigerous) females, a pair of egg sacks (ovisacs). It is not surprising then that copepod parasites of polychaete worms are generally overlooked by benthic ecologists. Those recorded in British waters have recently been reviewed within a synopsis of commensal and parasitic copepods associated with British marine invertebrates (Gotto, 1993). Environmental monitoring surveys of benthic invertebrate communities are proving a fruitful source of new finds of such copepods (O'Reilly, 1995a,b, 1999, Ooishi, 1996).

During the 1990s a small number of copepods from phyllodocid polychaete worms were collected by the author and colleagues in the course of routine marine benthic surveys in Scottish waters. The sampling generally involved collection of seabed sediments by mechanical grab and subsequent sieving on 0.5mm mesh. The retained fauna (and sediment residue) was fixed with formalin and returned to the laboratory for processing (water washing , and dyeing with Rose Bengal to aid sorting). All invertebrates were then picked out, identified, counted and placed in vials with alcohol. Any parasitised polychaetes were put aside for subsequent examination. Phyllodocids were identified using Pleijel & Dales (1991). The copepod material is detailed below along with an additional parasite recovered in the Irish Sea.

MATERIAL EXAMINED

(All the material is deposited in the National Museum of Scotland, Edinburgh)

PHYLLODICOLIDAE (Delamare-Deboutteville & Laubier, 1960)
***Cyclorhiza megalova* Gotto & Leahy, 1988**

Scottish Material:

a) **Bay of Ireland, Orkney Mainland**, coll. C. Caldwell, April 1990:

1 mature female, 0.7mm, detached from host (*Eteone longa* (Fabricius, 1780)). **NMSZ 2000.055.01**

b) **Loch Craignish, Argyll**, 10 m depth between Eilean Macaskin & Creag a Bhanan, coll. D. Ross, June 1991:

2 juvenile females, ovoid 0.4 and 0.5mm in length, attached on setigers 78(left) and 81 right) respectively of host (*Eteone longa* - 1.9cm long for 110 setigers, posterior missing). **NMSZ 2000.055.02**

c) **Firth of Clyde, Girvan**, SEPA Stn.R2 (55° 15.78'N, 4° 51.97'W, depth 10m) coll. M.O'Reilly, Aug.1998:

1 ovigerous female, 0.9mm with broken ovisacs, 0.9 and 1.2mm (plus 2 fragments 1.2 and 2.3mm), attached on setiger 45(left) of host (*Eteone longa* - 2.5cm long for 135 setigers, complete). **NMSZ 2000.055.03** (Fig. 1)

1 ovigerous female, 0.7mm with broken ovisacs 0.7 and 1.4mm, attached on setiger 37(left) of host (*Eteone longa* - 2.2cm long for 145 setigers, complete). **NMSZ 2000.055.04** (Fig. 2)

3 juveniles females, all around 0.15mm, attached on setigers 37(right), 60(right), 70(right) of host, (*Eteone longa* - 1.6cm long for 125 setigers, complete). **NMSZ 2000.055.05**

1 juvenile female, 0.1mm, attached on setiger 90(left) of host (*Eteone longa* - 2.0cm long for 130 setigers, incomplete). **NMSZ 2000.055.06**

Irish Sea Material:

a) **Irish Sea**, Block 109, Stn. 3, (53 o 45' 16.2"N, 4 o 07' 07.3"W, about 30 miles south-east of the Isle of Man), 46m depth,coll. S. Hamilton, Sept. 1995:

1 ovigerous female, 0.7mm with 1.4mm broken ovisac, attached on setiger 70(right) of host (*Eteone longa* - 1.5cm long for 115 setigers, complete). **NMSZ 2000.055.07**

***Phyllodicola petiti* (Delamare-Deboutteville & Laubier, 1960)**

a) **Firth of Clyde, Irvine Bay**, SEPA Stn.C, (55 o 33.60'N, 4 o 43.95'W, depth 36m) coll. M.O'Reilly Sept, 1989:

2 juvenile females, ovoid, both around 0.15mm, attached on setigers 38(left) and 41(right) of host (*Phyllodoce rosea* (McIntosh, 1877), 11mm for 50 setigers, incomplete). **NMSZ 2000.055.08**

b) **Firth of Clyde, Ayr Bay**, SEPA Stn. AB1 (55° 27.88'N, 4° 40.00'W, depth 10m) coll. M.O'Reilly, Sept 1989:

1 mature female, 0.3mm attached on setiger 11 (left) of host (*Eumida bahusiensis* Bergstrom, 1914, 42 setigers for 4 mm, complete). **NMSZ 2000.055.09** (Fig. 3)

c) Island of Mull, Loch na Keal, SEPA Stn. 22, June 1998:

1 ovigerous female, 0.2mm with ovisacs 0.6 and 1.2mm, attached on setiger 17(left) of host (?*Eumida sanguinea* (Orsted, 1843) , 5.5mm for 47 setigers, complete). **NMSZ 2000.055.10** (Figs. 4 & 5)

d) Firth of Clyde, Girvan, SEPA Stn.R2 (55° 15.78'N, 4° 51.97'W, depth 10m), coll. M.O'Reilly, Aug.1998:

1 ovigerous female, 0.3mm with ovisacs 0.8 and 1.1mm, attached on setiger 18(right) of host (*Eumida bahusiensis*, 9 mm for 50 setigers, complete). **NMSZ 2000.055.11** (Fig. 6)

1 mature female, 0.7mm and juvenile female, 0.1mm, on setigers 20(right) and 21(ventral) of host (*Eumida bahusiensis*, 7mm for 39 setigers,complete). **NMSZ 2000.055.12** (Figs. 7 & 8)

REVIEW OF COPEPODS RECORDED FROM PHYLLODOCID POLYCHAETES

There are few accounts of copepods associated with phyllodocid worms. The earliest reference is that of Saint-Joseph (1888 pp.295, 302) in his work on polychaetes of the French coast at Dinard. He observed an ovigerous copepod attached to a specimen of "*Eulalia pallida*" (=*Eumida sanguinea*) and another copepod on "*Eulalia macroceros*" (=*Pterocirrus macroceros* (Grube, 1860)) referring the latter to *Herpyllobius arcticus* Steenstrup & Lutken, 1861 a highly transformed parasitic copepod described more than 20 years earlier from a polynoid scaleworm off Greenland.

A few years later a new copepod parasite *Nereicola concinna* Scott, 1902 was described from *Eulalia viridis* (Linnaeus, 1767) collected in Loch Etive. Scott (1902) considered his speeies to be allied to *Nereicola ovatus* Keferstein, 1863 a parasite of nereid worms (see O'Reilly, 1995b) and then the sole member of the Nereicolidae. Several genera have since been added to this family and the hosts, where known, are all polychaetes. However only one genus is associated with phyllodocids and is represented by a single species, *Sigecheres brittae* Bresciani, 1964 ectoparasitic on *Sige fusigera* Malmgren, 1865 in Danish waters. As Gotto (1993) noted it seems almost certain that the copepod described by Scott is congeneric, or perhaps even conspecific with Bresciani's *S. brittae*. Further finds of this form are required to verify this postulation.

In 1942, Heegaard discovered an aberrant copepod on *Eteone longa* collected in Trondheimsfjord, Norway, which he named *Cyclorhiza eteonicola*. Heegaard placed Cyclorhiza in the family Herpyllobiidae on account of its grossly simplified morphology.

A new family, the Phyllodicolidae*, was established by Delamarc-Deboutteville & Laubier (1960a) to accommodate another parasite *Phyllodicola petiti* recovered from *Phyllodoce sp.* and *Eulalia pusilla* (=*Eulalia expusilla* Pleijel, 1987) in the eastern Mediterranean. Although Delamare-Deboutteville & Laubier (1960b) discussed the relationship of *Phyllodicola* with other copepod genera parasitising polychaetes, they were unaware of the existence of *Cyclorhiza*. Further illustrations of adult, juvenile, and nauplius stages were presented by Laubier (1961). Around the same time, Gotto (1961) discussed the phylogeny of the Phyllodicolidae and speculated on a neotenous derivation from monstrilloids.

It was not until new material of *Cyclorhiza eteonicola* was examined from eastern North America (Lutzen, 1964a) that its resemblance to *Phyllodicola* was realised. Lützen (1964b) subsequently removed *C. eteonicola* from the Herpyllobiidae (which then remained exclusively parasitic on polynoid scaleworms) and placed it in the Phyllodicolidae. Laubier (1966, pp.290-2) accepted that *Cyclorhiza* and *Phyllodicola* were closely related based on Lutzen's comments and unpublished notes by Southward on *C.eteonicola* material collected from the Irish Sea in the 1950s. He also highlighted a further find of an adult and juvenile *P.petiti* from *Pirakia punctifera* (Grube, 1860) in the eastern Mediterranean.

New material of *Cyclorhiza* was discovered by Gotto and Leahy (1988) off western Ireland. Although parasitising the same host as *C.eteonicola*, the Irish material was considered sufficiently distinct to warrant the erection of a new species which they named *Cyclorhiza megalova* on account of the relatively large eggs possessed by the ovigerous females.

Legends to figures (see opposite page)

Figure 1: *Cyclorhiza megalova* – female with ovisacs attached to *Eteone longa*.

The copepod body is club-shaped with the elongate posterior end bent over between the ovisacs.

Figure 2: *Cyclorhiza megalova* - female with ovisacs attached to *Eteone longa*.

The club-shaped copepod body is visible above the ovisacs with the posterior end bent to the left.

Figure 3: *Phyllodicola petiti* – mature female attached to *Eumida bahusiensis*.

Figure 4: *Phyllodicola petiti* – female with ovisacs attached to *Eumida sanguinea*.

The tiny body of the copepod is hidden by the ovisacs.

Figure 5: *Phyllodicola petiti* – female with ovisacs attached to *Eumida sanguinea*. The tiny oval body of the copepod is visible beside the ovisac.

Figure 6: *Phyllodicola petiti* –female with ovisacs attached to *Eumida bahusiensis*. The tiny body of the copepod is hidden by the ovisacs.

Figure 7: *Phyllodicola petiti*- mature female and juvenile attached to *Eumida bahusiensis*. The tiny oval juvenile is attached just to the left of the much larger mature female.

Figure 8: *Phyllodicola petiti* – mature female attached to *Eumida bahusiensis*.

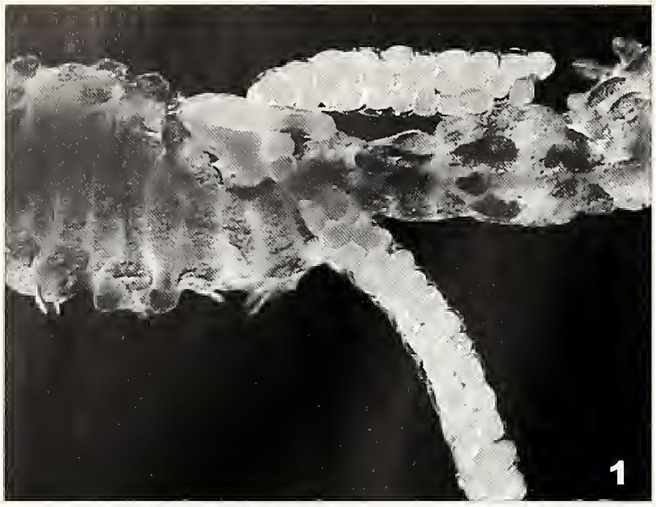
DISCUSSION

The sparsity of previous records of copepods from phyllodocid worms is not surprising. The copepods are very small and easily overlooked unless ovigerous. The nereicolids such as *Sigecheres* do have a discernible head with antennae and mouthparts, plus a distinct trunk and tail region and are probably recognisable to most observers as crustaceans of some sort. Nereicolids grasp their host with the oral appendages and thus are liable to become dislodged (and probably lost) from their host during sample sieving or fixing. The phyllodicolids on the other hand have clavate or ovoid bodies and although some cephalic appendages are present these are minute and difficult to observe even on slide mounted material. Phyllodicolids are firmly fixed to their hosts by a buccal siphon and two long rhizoids which penetrate some distance into the host's body. The only obvious indication of their copepodan nature is the relatively large paired egg strings of ovigerous females. Indeed the egg strings often completely obscure the small body of the copepod. Bresciani (1964) suggested that the copepods observed by Saint-Joseph (1888) might be referable to *Sigecheres*. However, Saint-Joseph's identification with *Herpyllobius arcticus*, although erroneous, does imply that their morphology was simplified and thus more akin to phyllodicolids than nereicolids.

Gotto & Leahy (1988) discuss the difficulty of interpreting Heegaard's inadequate type description of *C. eteonicola*. While they are satisified that Lützen's material from eastern North America is consistent with Heegaard's description they are convinced that their own Irish material is sufficiently distinct to establish a new species. *C. megalova* is distinguished by the smaller size of its ovisacs. However, the actual eggs are supposedly larger and as the ovisac matures they develop fibrillar attachment peduncles. Hence, of the Scottish material above, only the two ovigerous specimens can be referred with certainty to *C.megalova*. Gotto & Leahy supposed that Southward's unpublished record of *C.eteonicola* from off the Isle of Man was probably valid, as she had some ovigerous material. However, according to Laubier (1966), Southward observed "peduncular" attachment of the eggs, a characteristic of *C.megalova*. The recovery in 1995 of another ovigerous *Cyclorhiza* specimen south-east of the Isle of Man referable to *C. megalova* casts some doubt on Southward's original identification. The recent record of *C.eteonicola* from off the coast of Northumberland (O'Reilly & Geddes, 2000) comprises 5 non-ovigerous specimens collected in 1982 and thus could also equally be referred to *C.megalova*.

The status of *C.eteonicola* and validity of *C. megalova* clearly require investigation. While Gotto & Leahy suggest that the eggs of *C. megalova*, at 0.11mm, are much larger, examination of Heegaard's figure would indicate those of *C.eteonicola* are of a similar size, around 0.1mm (assuming the trunk of his copepod is 2mm as stated). However, the size of the ovisacs does appear to be different. Those of *C.eteonicola* attaining 8-10mm with 4 or 5 rows of eggs, whilst *C. megalova* ovisacs are around 2.5mm long (Irish material) or perhaps up to 3.2mm long (Scottish material) with 2 to 3 rows of eggs. It seems unlikely that the "fibrillar" attachment exhibited in maturing ovisacs of *C. megalova* (and *P.petiti*) is restricted to these species, and such a process would probably also occur in *C.eteonicola*.

Further material is required to confirm the distinction of these two species. At present the size of the ovisacs is the only reliable differentiating feature. It remains to be established whether *C.eteonicola* genuinely occurs in British waters.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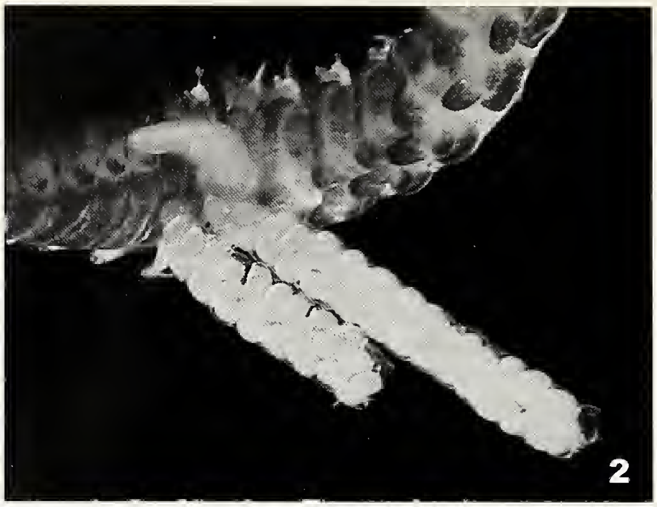
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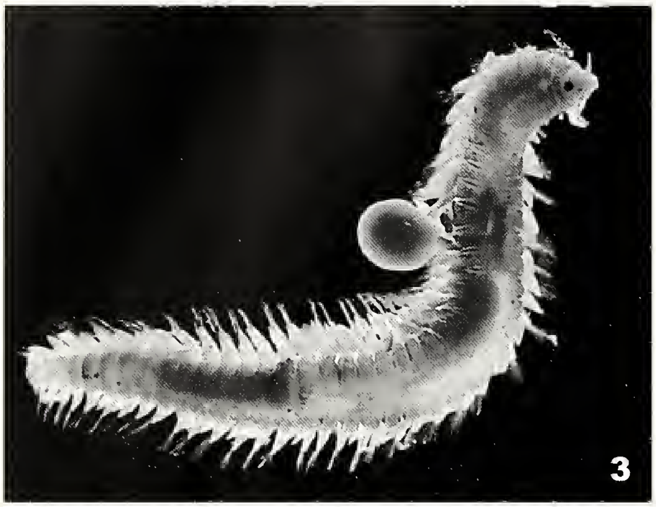
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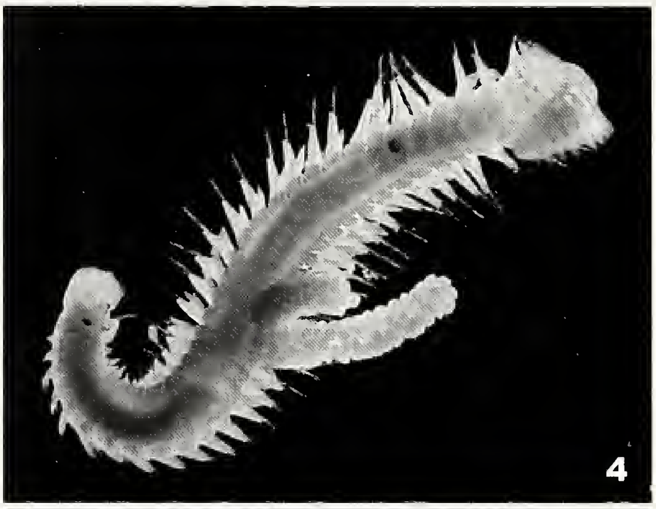
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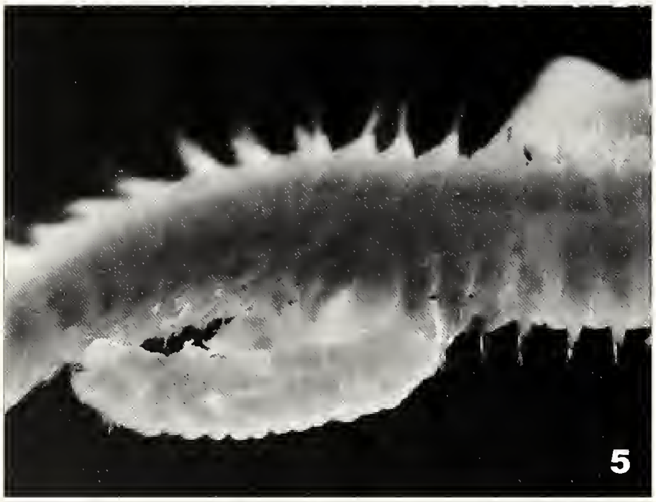
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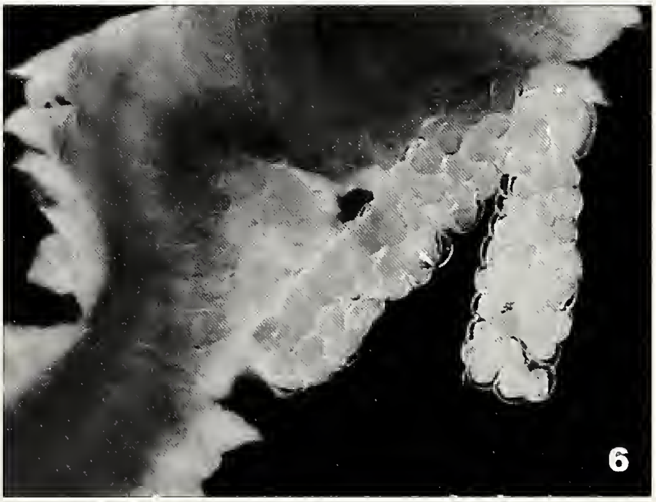
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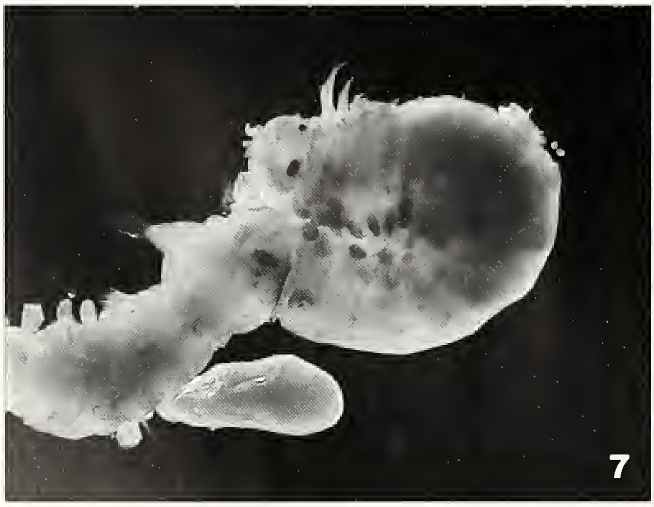
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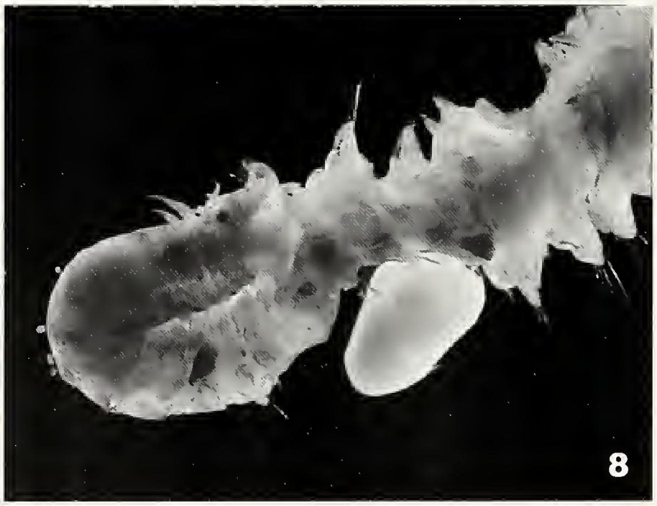
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The new finds of *P.petiti* appear to be the first records since Laubier's find in 1966 and represent a considerable extension of its known distribution. As far as can be determined the Scottish material is consistent with the initial descriptions provided by Delamare-Deboutteville & Laubier (1960a) and Laubier (1961) although the oral appendages have not been examined in detail as this would require damage to the specimens.

Mature females of the two phyllodicolid genera can be readily distinguished by the body shape. The extended urosome of *Cyclorhiza* results in an elongate clavate, or sausage, shape while *Phyllodicola* retains an irregulary ovoid body. Males remain unknown in either of the phyllodicolid genera and their discovery could help understand the phylogeny of the family. Specific determination of such small copepods with reduced morphology remains difficult. It might seem surprising that, on the one hand in *Cyclorhiza*, two separate copepod species exclusively adopt the same host species, whilst on the other hand, with *Phyllodicola*, it is assumed that only a single species is involved with five (or more?) acceptable phyllodocid host species. Neither situation is without precedent among polychaete parasites. In the melinnaeherids two sibling species, *Melinnacheres terebellidis* (Levinsen, 1878) and *M. steenstrupi* (Bresciani & Lützen, 1961) are both exclusively ectoparasites of *Terebellides stroemi* M.Sars, 1835. In contrast in the Xenocoelomidae, *Aphanodomus terebellae* (Levinsen, 1878) a grossly simplified endoparasite, is recorded from seven species of terebellid polychaetes (see O'Reilly, 1995b). Ultimately genetic studies may aid resolution of these questions.

*The family was initially named Phyllocolidae by Delamare-Deboutteville & Laubier (1960a). However as the type genus name, *Phyllocola*, had already been used for a genus of beetle, Delamare-Deboutteville & Laubier (1960c) subsequently modified the name to *Phyllodicola* with a corresponding emendation of the family name to its current form, Phyllodicolidae.

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THE COPEPOD *Hemicyclops aberdonensis* (POECILOSTOMATOIDA: CLAUSIDIIDAE) AND ITS SUSPECTED HOST THE BURROWING SHRIMP *Calocaris macandreae* IN THE FIRTH OF CLYDE

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The copepod family Clausidiidae contains several genera which live as commensals within the tubes or burrows of larger invertebrates (see Vervoort & Ramirez, 1966) . *Hemicyclops* is by far the largest genus within the family with over 30 species recognised worldwide. Although *Hemicyclops spp.* are free swimming and are often recovered in benthic plankton hauls, many of the species are also known to co-habit with other invertebrates. These include a sponge, a coral, a gastropod , a bivalve and an echiuran, but the most frequent hosts are burrowing crustaceans or polychaetes (Boxshall & Humes, 1987).

Only three species *H. purpureus* Boeck, 1872 , *H. aberdonensis* (T. & A. Scott, 1892), and *H. cylindracea* (Pelseneer, 1929) have been recorded from British waters. Of these only *H. cylindracea* is associated with any invertebrate, being found within the mantle cavity of the bivalve *Loripes lacteus* (see Gotto, 1993). *H. aberdonensis* is readily distinguished from the other two by the acute lateral protuberances on the genital segment.

In October 1992, during a routine benthic grabbing survey in Irvine Bay, Firth of Clyde, 8 female *H. aberdonensis* were recovered from a single grab of soft mud at SEPA Stn. E.(55 ° 33.60'N, 04°46.60'W, depth 53m). Although 38 grab samples were collected in Irvine Bay over 19 stations on the same survey, only one contained any *H. aberdonensis*. It is possible that the copepods came from sea-water hoses used to sieve the sediment samples. Most of the samples contained large calanoid copepods which almost certainly originate from the hose washing water. However the fact that the *H. aberdonensis* were recovered from only a single grab strongly suggests that they were living in close association with one of the invertebrates therein. The invertebrate fauna of the sample comprised 75 polychaetes (15 sp.), 17 nemerteans (2 sp.), 8 bivalves (3 sp.), 2 juvenile brittle stars, 1 amphipod, 1 decapod and 18 calanoid copepods. All of these are rather small to act as suitable host candidates with the exception of a single specimen of the burrowing decapod *Calocaris macandreae*. As this was the only adult *C. macandreae* recovered in the survey and burrowing decapods are one of the most frequent type of host for clausidiid copepods, it seems probable that the *H. aberdonensis* were co-habiting within the decapods' burrow. This case is strengthened by the discovery of an additional single female *H. aberdonensis* from 1 of 5 grab samples collected off Cloch Point (SEPA Stn.CMT7. 55 o 56.85'N, 04 o53.65'W, depth 80m) in April 1999. Again only the grab sample with the copepod had a *C. macandreae* present.

The *C. macandreae* specimen from Irvine Bay had a total length of 5cm (carapace length 1.7cm) and was also festooned with growths of the ctenostome bryozoan *Triticella flava* (Syn. *T. koreni*,see Hayward, 1985) on its rostrum and tail. Although the biology of *C. macandreae* has been studied in some detail, the only associate mentioned is the bryozoan epibiont (Buchanan, 1963; Eggleston, 1971). However, even if *H. aberdonensis* were regular co-habitees with *C. macandreae*, it is likely that the copepods would become separated from their host during normal sampling procedures. Recovery of copepods with *C. macandreae* would require in-situ sampling. As *C. macandreae* is quite abundant in some parts of the Clyde and the burrows are readily recognisable (Atkinson, 1986) it would be feasible for SCUBA divers to extract individual shrimps and their co-habitees from such burrows using a bait-pump or similar device.

The original description of *H. aberdonensis* is based on several specimens, both male and female collected in a bottom tow-net in Aberdeen Bay in 1891. In 1968 Hamond described a single male *Hemicyclops* sp., also collected in a bottom plankton net, off the coast of Norfolk. Hamond considered his specimen bore a striking resemblance to *H. aberdonensis* although there were a few discrepancies from the type description. A single female *H. aberdonensis* has since been recovered with a suction sampler in Dublin Bay and numerous males , females, and juveniles were collected using a light trap in Lough Ine, County Cork and at Carnac, Brittany (Holmes, 1985; Holmes, 1986; Holmes & O'Connor, 1991). Holmes (1986) commented on the inadequacy of the original description of this species and suggested that the original drawing of a female may have been based on a juvenile male. He regarded Hamond's male *Hemicyclops sp.* as clearly representing the male of *H.aberdonensis*.

The material from the Clyde throws some light on this problematical species. All the specimens appeared to be adult females (size range 1.3 - 1.5 mm excluding caudal setae) with a body shape similar to that depicted by T.& A. Scott (1892). However the genital segments are fused and thus only 3 post-genital segments are evident. The shape of the genital segments in the original figure of the female is more consistent with it being a genuine female rather than a male. The fact that the genital segments are figured with a clear segmental division may indicate the specimen was immature or may simply be an illustrative error. The acute lateral protuberances on the genital segments are one of the most distinguishing features of both sexes of this species.

One of the Irvine Bay specimens was dissected and mounted for more detailed observations of the antennae, mouthparts and legs (periopods P.1 to P.4)). The antennules (A1), antennae (A2), mandibles (Md), and maxillules (Mx1) are identical to those illustrated by Hamond for his male. The maxilla (Mx2) has two plumose setae on the first segment, as in the type description. The two setae are positioned close together, side by side. As one is slightly smaller it is quite easy for it to be obscured by the larger seta. This may explain why Hamond only observed one such seta in his male.

The formula for the arrangement of setae and spines in the Clyde female is as shown below (Arabic nos. = setae, Roman nos. = spines, first number is inner side of segment; second number is outer):

Leg /Segment		Endopodite	Exopodite
Leg 1	1	1 + 0	0 + I
(P.1)	2	1 + 0	1 + I
	3	5 + I	4 + IV
Leg 2	1	1 + 0	0 + I
(P.2)	2	2 + 0	1 + I
	3	3 + III	5 + IV
Leg 3	1	1 + 0	0 + I
(P.3)	2	2 + 0	1 + I
	3	2 + IV	5 + IV
Leg 4	1	1 + 0	0 + I
(P.4)	2	2 + 0	1 + I
	3	1 + IV	5 + III

This is similar to that illustrated for the male by Hamond except:

P.1, exp.3, innermost spine is very slender and "seta-like".

P.3, exp. has three segments with formula: 0 + I, 1 + I, 5 + IV.

P.4, end. 3, the single inner seta is short, robust and somewhat "spine-like" (fig. 1).

P.4, exp. 3 has three spines as in Hamond's formula (However Hamond's P.4 figure only shows 2 spines but there is a distinct gap between them suggesting that one spine may have fallen off.)

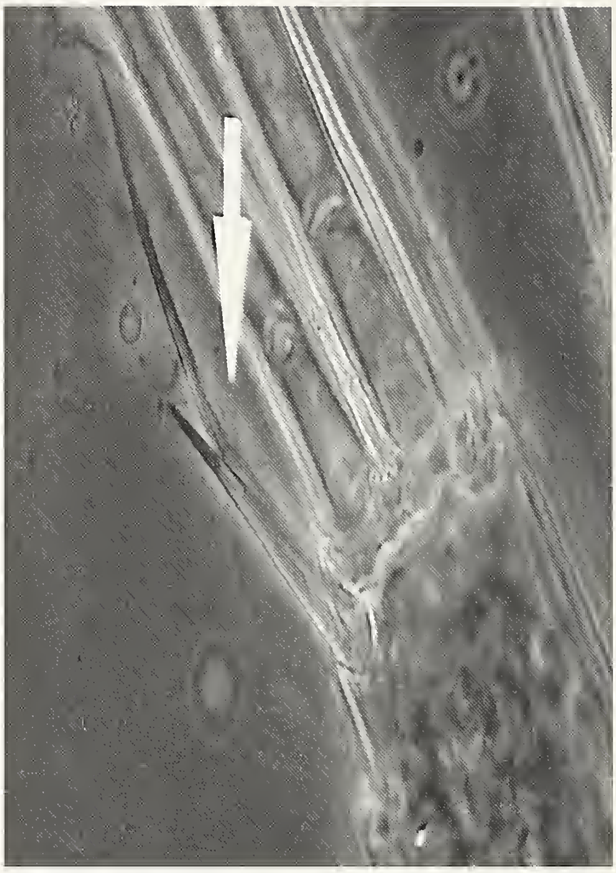

Fig 1. (see text)

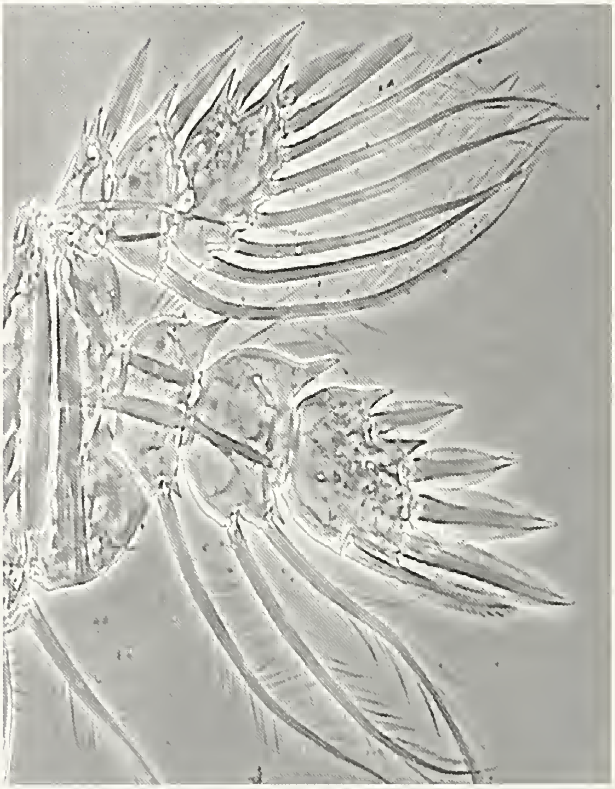

Fig 2. (see text)

Hence the main difference between the legs of the Clyde female and Hamond's male lies in the exopod of the third leg (P.3,exp.) which, in the male, is only two-segmented and has no setae or spines on the first segment and three spines (rather than four) on the last segment. (Note again that a distinct gap between the spines and setae of Hamond's figure for the last exp. segment suggests that one spine may have been dislodged.)

T.& A. Scott figured only the first and fourth legs. Whilst the armature of the first leg is consistent with that of the Clyde material, the figure of the fourth leg appears to have 2 extra setae on the third end. segment and one extra spine on the third exp.segment. As the leg armature does not usually vary within a species it is difficult to explain this discrepancy. It is possible that leg 4 was mixed up with either leg 3 or leg 2 although this would still leave an extra seta (for leg 3 last end.segment), or an extra spine (for leg 2 last end.segment).

Holmes (1986) mentioned that the lateral seta of the caudal ramus had a "curious bifid tip". A similar seta is also present in the Clyde material (Fig. 2). The seta is about the same length as the caudal ramus and has a distinctive furcate structure with a spine-like protrusion on the outer margin about halfway along its length. As Holmes observed this feature on some juvenile type material it may prove a useful additional character for verifying identifications. Despite the inaccuracies of the original description it is now clear that *H.aberdonensis* is a readily recognisable species and is probably much more widely distributed in British waters than the few scant records suggest.

Four whole females from Irvine Bay are deposited in the National Museum of Scotland, Edinburgh (Reg. Nos. NMSZ 2000 074.01-.04).

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SCOTTISH INSECT RECORDS FOR 1998 and 1999

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The aim of this compilation is to bring together records of interest that have come to the attention of field workers active in Scotland. In the following list, specific names of Lepidoptera are as in Kloet & Hincks (1972) and the reference numbers are as in Bradley (1998). As these entries are numbered, following the well-established system initiated by Bradley & Fletcher (1979) family names have been omitted. The new check list of the British Diptera (Chandler, 1998) has been used for that order. Other orders of insects follow the names that are given in Kloet & Hincks (1964, 1977, 1978).

ODONATA

LIBELLULIDAE

Libellula quadrimaculata Linn. Hallside Renewable Energy Park, nr Uddingston (NS666601), V.C.77, 10/7/99, SF.

Sympetrum striolatum (Charpentier). West Highland Way (NS529808), V.C.86, 8/8/99, JM.

S. nigrescens Lucas. Cnitneoch (NS403932), V.C86, 9/8/99, JM. This taxon is now usually being referred to as a northern form of *S. striolatum.*

PLECOPTERA

NEMOURIDAE

Protonemura praecox (Morton). Glenburn, Lomond Hills, Fife, in the burn (NO189057), V.C.85, 22/2/98, GBC.

HEMIPTERA HETEROPTERA

ACANTHOSOMIDAE

Acanthosoma haemorrhoidale (L.) Hawthorn Shieldbug. St Andrews, Fife, suburban garden, (NO493161), V.C.85, 7/10/98, GBC.

NABIDAE

Anaptis major (Costa). Lundin Links, Fife, dune scrub, (NO4102), V.C.85, 27/8/98, GBC.

MIRIDAE

Chlamydatus wilkinsoni (Douglas & Scott). Dumbarnie Links, Fife, dune slack, (NO439021), V.C.85, 30/7/99, GBC.

HEMIPTERA HOMOPTERA

CICADELLIDAE

Megophthalmus scanicus (Fallen). Inchcolm, Fife, coastal grass, (NT1982), V.C.85, 29/8/98, GBC.

Idiocerus confusus Flor, Craigluscar Reservoir, Fife, on *Salix cinerea*, (NT064902), V.C.85, 29/9/98, GBC.

Aphrodes flavostriatus (Donovan). Dumbarnie Links, Fife, dunes, (NO439021), V.C.85, 14/8-5/9/99, GBC.

Streptanus aemulans (Kirschbaum). Largo, Fife, dunes, (NO4104), V.C.85, 13/9/98, GBC.

Macustus grisescens (Zetterstedt). Largo Reservoir, Fife, fen, (NO4306), V.C.85, 1/6/98, GBC.

Kybos smaragdula (Fallen). Keil's Den, Largo, Fife, on Alnus, (NO4104), V.C.85, 29/10/98, GBC.

Eupteryx aurata (L.). Keil's Den, Largo, Fife, on Urtica, (NO4103), V.C.85, 3/11/98, GBC.

Eupteryx urticae (Fabr.). Keil's Den, Largo, Fife, on Urtica, (NO4103), V.C.85, 3/11/98, GBC.

Fagocyba carri Edwards. Colinsburgh, Fife, on Quercus, (NO462037), V.C.85, 8/11/98, GBC.

PSYLLIDAE

Trioza remota Förster. Humbie Wood, Fife, on *Quercus*, (NT1986), V.C.85, 29/9/98, GBC.

THYSANOPTERA

THRIPIDAE

Limothrips denticornis Haliday. Dumbarnie Links, Fife, dunes, (NO442021), V.C.85, 23/11/99, GBC.

NEUROPTERA

HEMEROBIIDAE

Hemerobius humulinus L. Keil's Den, Largo, Fife, mixed woodland, (NO4104), V.C.85, 29/10/98, GBC

TRICHOPTERA

HYDROPSYCHIDAE

Hydropsyche angustipennis (Curtis). Larvae in Kinnaird Burn, Black Spout Wood, nr Pitlochry, Perthshire, (NN949580), V.C.89, 29/5/99, BM.

LEPIDOPTERA

425 *Yponomeuta padella* (L.). Nr Elginhaugh, Dalkeith, Midlothian, larvae on hawthorn hedge (NT3167), V.C.83, 17/6/99, KPB. This is a rare species in southeast Scotland.

472 *Digitivalva pulicariae* (Klimesch). Kildonan, Isle of Arran, larvae on fleabane adults emerged subsequently (NS0121), V.C.100, 26/6/99, KPB. New to Scotland.

524 *Coleophora lithargyrinella* Zeller. Dalkeith Park, Midlothian, feeding on stitchwort (NT3368), V.C.83, 22/8/99, KPB. New vice-county record.

586 *C. adjunctella* Hodgkinson. Margnaheglish, Isle of Arran, swept on saltmarsh (NS0432), V.C.100, 27/6/99, KPB. Genitalia checked, new vice-county record.

616 *Elachista bedellella* (Sircom). Kinnoull Hill, Perthshire, larvae mining *Helictotrichon pratense,* emerged 18-23/5/99 (NO1322), V.C.89, 24/4/99, KPB. New to vice-county and only second Scottish record.

826 *Caryocolum vicinella* (Douglas). Isle of May, Fifeshire, male resting on *Silene maritima* (NT6599), V.C.85, 29/8/99, KPB. New vice-county record.

892 *Mompha subbistrigella* (Haworth). Blackford, Edinburgh, mv light trap (NT2571), V.C.83, 27-28/5/99, KPB.

1290 *Chilo phragmitellus* (Hübner). Paddockmuir Wood, St Madoes, nr Perth, many at light (NO2119), V.C.89, 16/7/99, JC.

1385 *Ebulea crocealis* (Hübner). Kildonan, Isle of Arran (NS0121), V.C.100, 26/6/99, KPB. New to vice county.

1426 *Achroia grisella* (Fabr.). Paddockmuir Wood, St Madoes, nr Perth, one at light (NO2119), V.C.89, 2/8/99, JC.

1545 *Colias croceus* (Geoffroy). Clouded Yellow. Old Kilpatrick, one at roadside (NS470720), V.C.99, 20/9/98, KF.

1555 *Callophrys rubi* (L.). Green hairstreak. Upper Glen Fruin, (NS260917), V.C.99, 16/6/98, JM.

1557 *Neozephyrus* (= *Quercusia*) *quercus* (L.). Purple hairstreak. Dumgoyach, several seen in oakwood (NS378958), V.C.86, 8/8/99, JM.

1643 *Saturnia pavonia* (L.). Emperor moth. Stuath Dubh-uisage, on heather (NN330160), V.C.99, 21/5/98; Duke Murdoch's bog, Loch Ard forest, larvae (NN465014), V.C.87, 28/7/99, JM.

1618 *Erebia aethiops* (Esper). Scotch argus. Cruach Tarbet, several individuals at top end of forestry ride (NN313051), V.C.99, 26/8/99, JM.

1752 *Cosmorhoe ocellata* (L.). Dumbarton, adult in house (NS387753), V.C.99, 26/2/98, KF & SF.

1904 *Plagodis dolabraria* (L.). Paddockmuir Wood, St Madoes, nr Perth, many at light (NO2119), 20/5/99, JC.

1929 *Lycia lapponaria* (Boisduval). Carn an T-Sionnaich, Fealar, Perthshire, larvae on *Calluna vulgaris* (NO0075), V.C.89, 14/7/99, KPB. The site is unusually high at 640m (2100ft) for this species; adults emerged in April 2000.

1972 *Agrius convolvuli* (L.). Convolvulus hawkmoth. Killearn, in house conservatory (NS522856), V.C.86, 29/8/99, JM.

2280 *Acronicta leporina* (L.). Blackford, Edinburgh, mv light trap (NT2571), V.C.83, 15-16/6/99, KPB. New vice county record.

2391 *Chilodes maritimus* (Tauscher). Paddockmuir Wood, St Madoes, nr Perth, one at light (NO2119), V.C.89, 16/7/99, JC.

COLEOPTERA

CARABIDAE

Leistus fulvibarbis Dejean. Corrie, Arran (NS0243), V.C.100, 27/6/99, SB.

Broscus cephalotes (L.). Drumadoon, Arran (NR8828), V.C.100, 26/6/99, SB; Gailes dune system, Troon, Ayrshire, (NS3236), V.C.75, 5/6/1999, EGH. Red Data Book status 'Notable B'.

Bembidion andreae (Fabr.). Loch Beannacharain (NH2251), V.C.106, 27/6/98, SB.

Bembidion biguttatum (Fabr.). Nr Crieff (NN9425, NO0415 & NN9422), V.C.88, 5-6/98, SB

Bembidion decorum (Zenker in Panzer). River Meig (NH2651), V.C.106, 27/6/98, SB.

Bembidion doris (Panzer). River Conon (NH4854), V.C.106, 27/6/98, SB.

Bembidion mannerheimi Sahlberg. Shiskine, Arran (NR9130), V.C.100, 26/6/99, SB.

Bembidion obtusum Serville. Nr Dunbar, East Lothian, one female swept in dune area (NT648790), V.C.82, 1/9/99, MS.

Bembidion pallidipenne (Illiger). Drumadoon, Arran (NR8828), V.C.100, 26/6/99, SB. Red Data Book status 'Notable'.

Bembidion tetracolum Say. Cleats Shore, Arran (NR 9420), V.C.100, 26/6/99, SB.

Pterostichus cristatus (Dufour). Nr Crieff (NN9315), V.C.88, 6/98, SB. Red Data Book status 'Notable B'.

Pterostichus rhaeticus Heer. Strathconon, Ross, one female in a muddy seep (NH262508), V.C.106, 2/7/98, MS.

Calathus piceus (Marsham). Leven, Fife, (NO390020), V.C.85, 26/10/99, GBC.

Synuchus nivalis (Panzer). Cleats Shore, Arran (NR9421), V.C.100, 26/6/99, SB.

Agonum gracile Sturm. River Meig (NH3556), V.C.106, 27/6/98, SB.

Amara aulica (Panzer). Cleats Shore, Arran (NR9521), V.C.100, 26/6/99, SB.

Amara familiaris (Duftschmid). Cleats Shore, Arran (NR9420), V.C.100, 26/6/99, SB.

Amara ovata (Fabbr.). Drumadoon, Arran (NR8828), V.C.100, 26/6/99, SB.

Amara plebeja (Gyllenhal). Cleats Shore, Arran (NR9420), V.C.100, 26/6/99, SB.

Amara tibialis (Paykull). Nr Auchterarder (NO0111), V.C.88, 6/98, SB.

Dromius notatus Stephens. R. Conon (NH4854), V.C.106, 27/6/98, SB.

Cymindis vaporariorum (Linn.). Nr Crieff (NN9225), V.C.88, 7/98, SB. Red Data Book status 'Notable B'.

DYTISCIDAE

Hygrotus quinquelineatus (Zetterstedt). Loch of Aboyne, South Aberdeenshire (NO5399), V.C.92, 1998, AG; Lower Glenamour Loch, Kirkcudbrightshire (NX4467), V.C.73, 14/11/99, GNF.

Hydroporus longicornis Sharp. Holy Island, Arran

(NS0630), V.C.100, 27/6/99; Kingarth, Glen Lednock (NN7624), V.C.88, 15/5/99; fen north of Balfron, Stirlingshire (NS5290), V.C.86, 8/4/99, GNF.

Deronectes latus (Stephens). Glack Burn, Arran (NR8934), V.C.100, 26/6/99, DTB.

Ilybius guttiger (Gyllenhal). Auchness, Mull of Galloway, Wigtownshire(NX107445), V.C.74, 6/8/98, GNF.

I. subaeneus Erichson. Torrs Warren, Wigtownshire (NX1153), V.C.74, 29/5/99, GNF.

Acilius canaliculatus (Nicolai). Lower Glenamour Loch , Kirkcudbrightshire (NX4467), V.C.73, 14/11/99, GNF.

HYDROPHILIDAE

Helophorus strigifrons Thomson. Aber Moss, Dunbartonshire (NS4387), V.C.99, 17/9/99, GNF.

Cercyon ustulatus (Preyssler). Black Spout Wood, Pitlochry, Perthshire, pitfall trap in broad leaved woodland adjacent to Kinnaird Burn (NN949580), V.C.89, 22/7/99, GRC.

Laccobius atratus (Rottenburg). Glen Rosa, Arran, (NR9741), V.C.100, 26/6/99, RC.

Cymbiodyta marginella (Fabr.). Mull Hill, Kirkmabreck, Wigtownshire (NX102483), V.C.74, 26/8/98; Torrs Warren, Wigtownshire (NX1153), V.C.74, 29/5/99, GNF.

HYDRAENIDAE

Hydraena pygmaea Waterhouse. Benlister Glen, Arran, Clyde Isles (NS0030), V.C.100, 26/6/99, DTB.

SILPHIDAE

Aclypea opaca (Linn.). Tomdachoille, R. Tummel (NN9655), V.C.89, 18/8/98; Cleats Shore, Arran (NR9420), V.C.100, 26/6/99, SB. Red Data Book status 'Notable A'.

Dendroxena quadrimaculata (Scopoli). Black Spout Wood, Pitlochry, Perthshire, oak woodland (NN949580), V.C.89, 29/5/99, GRC.

STAPHYLINIDAE

Micropeplus fulvus Erichson. Newburn, Fife, compost, (NO453035), V.C.85, 7/6/99, GBC.

Stenus bifoveolatus Gyllenhal. Red Myre, Fife, marsh, (NO254140), V.C.85, 22/3/99, GBC.

S. niveus Fauvel. Nr Morebattle, Roxburghshire, one female sifted from Sphagnum in fen (NT791253), V.C.80, 22/5/98; Danskine, East Lothian, one female by general sweeping in marshy woodland (NT569680), V.C.82, 20/6/98, MS. Red Data Book category 'Notable'.

Staphylinus erythropterus Linn. Fleecefaulds, Fife, marsh, (NO399085), V.C.85, 30/1/99, GBC.

Quedius fulvicollis (Stephens). Red Myre, Fife, (NO254140), V.C.85, 22/3/99, GBC.

Q. fumatus (Stephens). Red Myre, Fife, (NO254140), V.C.85, 22/3/99, GBC.

Q. mesomelinus (Marsham). Newburn, Fife, (NO453035), V.C.85, 4/4/99, GBC.

Mycetoporus despectus Strand. Nr Dunbar, East Lothian, one male swept by a pond (NT650790), V.C.82, 25/7/99, MS. Red Data Book category 'Notable'.

Atheta (Microdota) amicula (Stephens). Deerness, Orkney, one female swept in sandy area (HY551035), V.C.111, 24/5/1999 MS. Probably first vice-county record for this species.

Aleochara brevipennis Gravenhorst. Black Spout Wood, Pitlochry, Perthshire, grass and scrub area in oak woodland on site of former rubbish dump, (NN952579), V.C.89, 29/5/1999, GRC.

Aleochara ruficornis Gravenhorst. Black Spout Wood, Pitlochry, Perthshire, swamp area in broad-leaved woodland, (NN951578), V.C.89, 29/5/1999, GRC.

LUCANIDAE

Sinodendron cylindricum (L.). Tomdachoille, R. Tummel (NN9655), V.C.89, 18/8/98, SB.#

GEOTRUPIDAE

Geotrupes spiniger (Marsham). Dumbarnie Links, Fife, horse dung, (NO439022), V.C.85, 5/9/99, GBC.

Aphodius sphacelatus (Panzer). Dumbarnie Links, Fife, dunes, (NO442021), V.C.85, 19/6/99, GBC.

SCIRTIDAE

Cyphon laevipennis Tournier (formerly known as *C. phragmiteticola* Nyholm). Torrs Warren, Wigtownshire (NX 1253), V.C.74, 29 /5/99, GNF.

BYRRHIDAE

Byrrhus pustulatus (Forster). Dumbarnie Links, Fife, dunes, (NO442021), V.C.85, 25/5/99, GBC.

ELATERIDAE

Selatosomus impressus (Fabr.). Black Spout Wood, Pitlochry, Perthshire, broad-leaved woodland (NN954577), V.C.89, 22/7/99, GRC.

Agriotes pallidulus (Illiger). Keil's Den, Largo, Fife, on hawthorn, (NO4104), V.C.85, 15/6/99, GBC.

DERODONTIDAE

Laricobius erichsoni Rosenhauer. Nr Dunbar, East Lothian, two male and one female beaten from Scots pine (NT648790), V.C.82, 24/8/99, MS. An introduced species which is spreading rapidly.

LATHRIDIIDAE

Lathridius minutus (L.). Nr Selkirk, two males sifted from heap of grass cuttings in edge of wood in company of an abundance of *Lathridius anthracinus* Mannerheim (NT479263), V.C.79, 21/9/99, MS. A rarely recorded species in Scotland.

TENEBRIONIDAE

Bolitophagus reticulatus (L.) Corrimony (NH3729), V.C.106, 6/98; Kincraig (NH8303), V.C.94, 5/99, SB. Red Data Book 'Category 3'.

CHRYSOMELIDAE

Chrysolina oricalcia (Müller). Denholm, Roxburghshire, one female on leaf of hogweed (NT566191), V.C.80, 4/7/99, MS. A very scarce species in southern Scotland; Red Data Book category 'Notable'.

Clytra quadripunctata (L.). Nr Corrimony Falls, Inverness, one male in flight in woodland (NH374291), V.C.96, 27/6/98, MS.

Sphaeroderma rubidum (Graëlls). Dumbarnie Links, Fife, dunes, (NO439022), V.C.85, 14/8/99, GBC.

APIONIDAE

Apion carduorum Kirby. Dumbarnie Links, Fife, dunes, (NO438023), V.C.85, 5/9/99,GBC.

CURCULIONIDAE

Otiorhynchus scaber (L.). Loch Achilty, Ross, two males beaten from alder and birch (NH432571), V.C.106, 29/6/98, MS; Black Spout Wood, Pitlochry, Perthshire (NN954577), V.C.89, 22/7/99, GRC. RDB category 'Notable'.

Tropiphorus obtusus (Bonsdorff). Black Spout Wood, Pitlochry, Perthshire, broad-leaved woodland (NN949580), V.C.89, 22/7/99, GRC.

Sitona suturalis Stephens. Fleecefaulds, Fife, (NO399085), V.C.85, 30/1/99, GBC.

Ceutorhynchus assimilis (Paykull). Keil's Den, Largo, Fife, (NO 4104), V.C.85, 18/3/99, GBC.

C. pollinarius (Forster). Newburn, Fife, on Urtica , (NO453035), V.C.85, 2/6/99, GBC.

Rhynchaenus fagi (L.). Keil's Den, Largo, Fife, on Alnus, (NO413034), V.C.85, 28/8/98. GBC.

DIPTERA

PEDICIIDAE

Dicranota guerini Zetterstedt. Papana Water SSSI, East Lothian, recorded from streamside vegetation (NT587678), V.C.82, 18/7/99, DS. This cranefly is generally an upland species but may be the acidic nature of Papana Water has attracted it to this lowland site.

LIMONIIDAE

Gonomyia recta Tonnoir. Figgate Park, Edinburgh, swept from streamside vegetation (NT293733), V.C.83, 14/6/98 & 13/6/99, DS. These appear to be the first published Scottish records.

Molophilus variispinus Stary. Papana Water SSSI, East Lothian, recorded from streamside vegetation (NT586685), V.C.82, 18/7/99. DS. Added to the British fauna in 1977; Red Data Book category 'Notable'.

Limonia trivittata (Schummel). Figgate Park, Edinburgh (NT293733), V.C.83, 14/6/98; Papana Water SSSI, East Lothian (NT586685), V.C.82, 18/7/99, DS. Found amongst streamside vegetation in both cases; Red Data Book category 'Notable'.

Dicranomyia ornata (Meigen). Figgate Park, Edinburgh, amongst butterbur on very boggy ground (NT299737), V.C.83, 29/5/99, DS. Red Data Book category 'Notable'.

PTYCHOPTERIDAE

Ptychoptera contaminata (L.). North Berwick Law, Lothian (NT555844), V.C.82, 16/8/97; Mavisbank Pond (NT289654), V.C.83, 27-31/8/98, BS; Figgate Park, Edinburgh, frequently seen amongst *Glyceria maxima* beds at the pondside (NT299737), V.C.83, 5-6/98, DS.

TABANIDAE

Tabanus sudeticus Zeller. Southern slopes of Ben Lui at 480m (NN262242), V.C.87, 27/7/99; shore of Loch Lomond (NS378958); V.C.86, 3/8/99, JM; Balloch, Dumbartonshire (NS378813), V.C.99, 11/7/99, KF.

HYMENOPTERA

ARGIDAE

Arge cyanocrocea (Forster). Newburn, Fife, on *Anthriscus sylvestris*, (NO453035), V.C.85, 17/6/99, GBC. A number of other observations of this species (DS) have been made, usually amongst its bramble foodplant. An investigation is underway in the Edinburgh area to establish the local distribution and population levels and ascertain if its status is that of a recent coloniser that is spreading.

CYNIPIDAE

Diplolepis spinosissimae (Giraud). Lundin Links, Fife, dune scrub on *Rosa pimpinellifolia*, (NO413024), V.C.85, 3/9/99, GBC.

CHRYSIDIDAE

Chrysis impressa Schenk. Newburn, Fife, indoors, (NO453035), V.C.85, 7/6/99, GB

FORMICIDAE

Myrmica ruginodis Nylander. Inchconnachan, Loch Lomond (NS3791), V.C.99, 18/5/99, JM.

Formica aquilonia Yarrow. Cailness, Inversnaid (NN3409), V.C.86, 2/5/99; Inchconnachan, Loch Lomond (NS3791), V.C.99, 18/5/99, JM.

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SHORT NOTES

Compiled by A.McG. STIRLING

BOTANICAL

The hawkweed *Hieracium lasiophyllum* on Ailsa Craig, Ayrshire

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In my Flora of Ailsa Craig (Zonfrillo, 1994) I made brief mention of the hawkheed *Hieracium sp.* collected there and the fact that its identification was uncertain. Past records e.g. in J.R. Lee's *Flora of the Clyde Area* (1933) referred the Ailsa records as *Hieracium murorum*, now a *nomen nudum*. Having had time to collect a further few specimens over the past 5 years it is now possible to put a specific name to the species. *Hieracium* specialist Mr D. J. McCosh has now examined all the known voucher specimens held in the herbarium at Glasgow University and compared them with extensive collections of other material. He informs me that, although not quite matching in every detail, the Ailsa hawkweed agrees well with the taxon *Hieracium lasiophyllum* Koch., a local plant of dry rocks. The nearest known stations to Ailsa Craig of *H. lasiophyllum* are in the Lake District (Cumbria) and in Fife and Stirlingshire.

On Ailsa it occurs on mainly the south west side of the island, usually on the cliffs, well away from attack by rabbits. It is rather scarce and perhaps numbers fewer than 20 plants in all. It is a late flowering *Hieracium* appearing regularly in late June, usually among the Cat's Ear *Hypochaeris radicata* on earthy ledges and growing from cracks in the dolerite seams. *H. lasiophyllum* on Ailsa Craig will be monitored in future years.

I am indebted to David McCosh for his painstaking work in identifying the specimens and for details of its distribution and to Prof. J.H. Dickson for arranging examination of specimens.

Reference

Zonfrillo, B. (1994) Flora of Ailsa Craig. *The Glasgow Naturalist* **22**, 307-44.

Nuphar advena established at Corehouse

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Over the years references have been made to a water lily growing in a pond at Corehouse, Falls of Clyde, Lanarkshire (VC 77). Birnage (1975) described it as "a unique micro-species of Yellow Water Lily" and in a Scottish Wildlife Trust report (1986) it was regarded as *Nuphar x spennerana*, the hybrid between yellow water-lily (*N. lutea*) and least water-lily (*N. pumila*).

At a visit to the site in 1997 (PM) it was noted that the ornamental pond had long since been abandoned and had degenerated into a swamp with the edges encroached by willow scrub. In 1999 it was appreciated that the *Nuphar* leaf blades were held up out of the water, suggesting the possibility of *N. advena* (spatter-dock). By wading into deep water (JW) a flower in bud was obtained. This was placed on a narrow necked vase with the stalk extending down into water. Initially the petals appeared to be wholly yellow, but as the flower opened they became red-tinged, typical of *N. advena* (Fig. 1 next page). This plant is a native of E.N. America.

Clement & Foster (1994) give five records for the British Isles, three in Surrey (VC 17) and two in Scotland. The latter sites are Loch Ard in West Perthshire (VC 87) and Carlingwark Loch, Kirkcudbrightshire (VC 73).

The Corehouse plant has obviously been established for many years, but not recognised as *N. advena* until now.

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Abnormal water avens morphology – lead induced?

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Water avens (*Geum rivale*) is known to occur in a proliferative form (McClintock & Macpherson 1995) and over the years sporadic specimens have been seen in Lanarkshire (VC 77), including the burnsides north of Leadhills.

Fig. 1 ***Nuphar advena*** **from Corehouse: partially opened flower.**

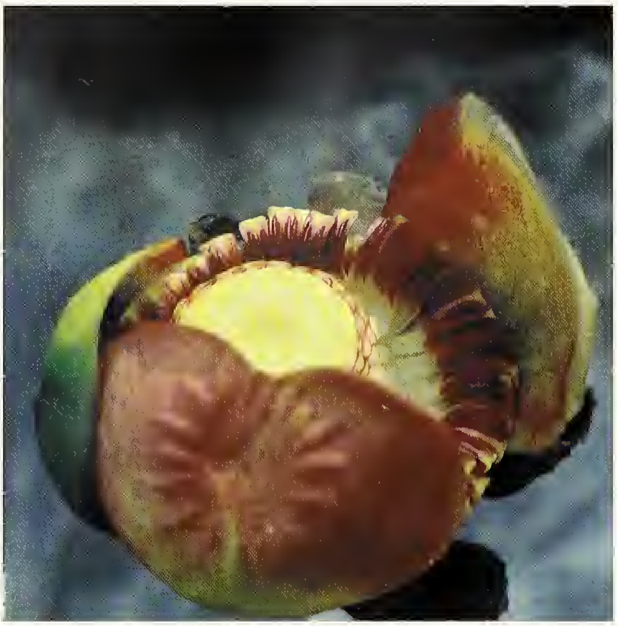
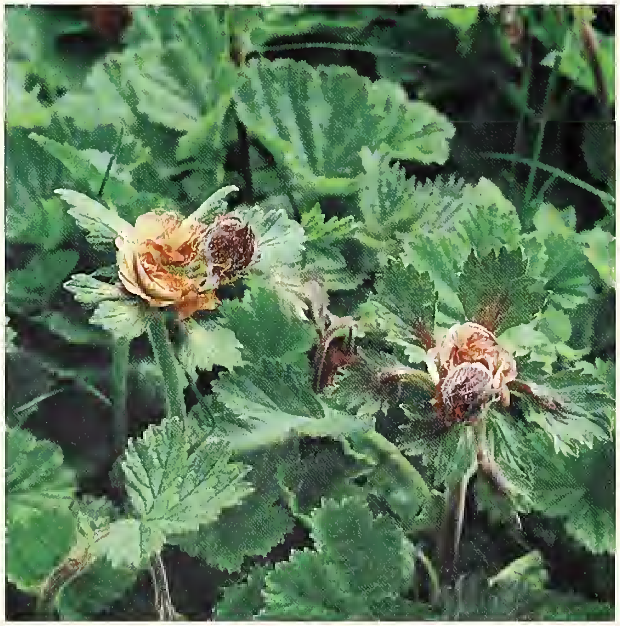


Fig. 2 **Mat-forming water avens with** ***flore pleno*** **and proliferative anomalies.**



In 1998 and 1999 detailed surveys were undertaken in that region. Between a slag heap and a burn, in an area of 40 square yards, compact dwarf plants were seen forming fairly solid ground cover. Many were double-flowered, some proliferative and some had both these features (Fig. 2, this page). Within 100 yards of this site many slightly taller plants were noted, some exhibiting one or other of the above abnormalities.

In view of the extreme frequency of the anomalies at this location I wonder if they are related to the high lead content in the soil.

Reference

McClintock, D. & Macpherson, P. (1995). An aberrant *Geum*. *That Plant's Odd* **5**, 2-3.

Water chickweed (*Myosoton aquaticum*) in a growbag in Milngavie

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I have used growbags for a number of years and have had the occasional seedlings appearing in them e.g. *Persicaria spp.* (1998), and in 1999 it showed up in the vegetable bed where the spent growbag was used. Dandelion (*Taraxacum agg.*) and stinging nettle (*Urtica dioica*) and others appeared in 1999. I am not very thorough when it comes to weeding and if coming across a seedling I do not recognise it is left alone until it can be identified. This could well have led to the discovery of the water chickweed in 1999, confirmed by Prof. J.H. Dickson, when it turned up among my sweet peas in a growbag. It pays to be not too fussy when weeding. One never knows what might turn up!

Water chickweed is common in southern Britain but very rare in Scotland and the occurrences in the Glasgow area are the northernmost. It normally inhabits wet places such as stream-sides and ditches but according to Burton (1983) it can also flourish on dry ground.

In the *The Changing Flora of Glasgow* (Dickson *et al.*, 2000) the local occurrences are listed as follows: "Four modern records are associated with the Clyde: Uddingston (T70), Cambuslang (T68), Dalbeth Cemetery (T57) and the Garden Festival site (T44). Two other records are from waste ground, Barlanark (T27) and a flooded disused railway at Lambhill (T25). The plant is only well established at Uddingston where it grows with wood stitchwort (*Stellaria nemorum*). This is one of very few places in Britain where these two plants are known to be found intermixed".

The peat with which the growbag was made up will most likely have been sedge or fen peat from an area such as Somerset, as the *Myosoton* avoids acid soil.

If seeds of water chickweed are transported in peat-based compost as used in growbags then its occurrences in places like the Garden Festival site can be readily explained.

Myosoton differs from wood stitchwort in having sessile leaves and five styles opposed to three. Both have petals bifid almost to the base giving the illusion of ten petals. It is self fertile and probably self pollinating as a cutting of it flowered and set seed in late summer/autumn 1999 in my greenhouse.

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ZOOLOGICAL

Casual record of Adonis' ladybird (*Adonia variegata*) in Dumbarton

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On 15th March 1999 we found a specimen of Adonis' ladybird (*Adonia variegata*) in our kitchen. As Adonis' ladybird is absent from Scotland (Majerus, 1994) and a rarity in England (Majerus, 1995) we were very surprised by this find. On the 17th March we found a further example of Adonis' ladybird, in our house, resting on grapes we had purchased from the local Safeway store. We surmised that the source was hibernating individuals on grapes (country of origin, Italy) which had become active, being awakened from hibernation by the heat of the house. Both Adonis' ladybirds were of the 13 spot variant, as described in Majerus & Kearns (1989), plate 6.

Adonis' ladybirds are uncommon in Britain with a disjunct and erratic distribution and occurrence (Majerus, 1995). As Adonis' ladybird is common in southern Europe and the Mediterranean (Majerus, 1995) it is possible that some of the British records for this species are also casual records *via* produce imported from Europe.

We thank Geoff Hancock and Richard Sutcliffe for verifying the identification and John Mitchell for encouragement. The specimens were presented to Glasgow Museums.

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Xylocoris cursitans (Fallen) (Hemiptera: Anthocoridae) new to Scotland, from Roxburghshire

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Xylocoris cursitans is a predatory bug which lives beneath the bark of dead trunks and limbs which are in the early stages of decay, especially oak and beech, but also in a wide range of trees including conifers. It feeds on insect larvae, springtails, thrips, etc. It is fairly widespread in the ancient woodlands and wood pastures of England and Wales, but has not previously been reported from Scotland.

The Jedwater Woodlands at Sunnybraescaur (NT6518), Roxburghshire, are a valuable area of large old oak standards which support an unusually diverse wood-decay invertebrate fauna which is characteristic of southern temperate broad-leaved wood pastures. Adults and nymphs of the bug *Xylocoris cursitans* were found beneath bark on fallen oaks, 23.v.1999, together with *Rhizophagus dispar* (Paykull) beetles – a potential prey item. Other significant finds were the beetles *Cerylon histeroides* (F.), *Rhizophagus ferrugineus* (Paykull) and *Dryocoetinus villosus* (F.) and the cranefly *Ctenophora bimaculata* (L.). This would not be a particularly interesting assemblage in England but is certainly so in Scotland.

Thanks to Graham Rotheray for confirming that there are no published records for this bug from Scotland according to the Scottish Insect Records Index at the National Museums of Scotland; also to Stephen Hewitt and Stephen Moran for checking their own data.

The genus *Aradus* in Scotland and the confusion of *corticalis* (L.) with *A. betulae* (L.), Hemiptera-Heteroptera, Aradidae

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The present distribution and biology of the bark bug *Aradus betulae* (L.) has been summarised recently (Bland, *et al.* 1999). I had already searched through the extensive insect collection of the University of Glasgow, Hunterian Museum (Zoology) for aradid material for this review, or so I thought, and had been able to supply some records. So it was with some astonishment recently that I opened a drawer of an old cabinet and saw a large number of preserved specimens of bark bugs from Rannoch. Also, as they were labelled *Aradus corticalis* (L.) they might have been the source of the statement in Southwood & Leston (1959) that this species is 'perhaps incorrectly (known) from Scotland'. The occasion presented an opportunity to sort out the small confusion as to which species do occur here.

The specimens in this forgotten batch are actually *A. betulae* (L.), all from Rannoch and collected in July and August, 1917 by J.J.F.X. King. There are 56 males, 66 females and 10 nymphs (plus the exuviae of six penultimate instars) and indeed are the basis of the contemporary account as to the supposed discovery of *A. corticalis* by King (1917). At that time *betulae* was unknown in Britain, not being officially added until some time later (Harwood, 1921). The differences between *betulae* and *corticalis* are small and the two are not easily distinguished. Although King collected extensively in the New Forest he does not appear ever to have found true *corticalis*. There are as yet still no specimens for comparison in the university collection, reflecting its rarity and occurrence only in the south of Britain. King casually labelled his Scottish material *corticalis* on the scrap of paper inside the box and did not realise the possible confusion between the two species even when *betulae* was reported from the same place a few years later (Harwood, 1921). So it appears that *corticalis* does not occur in Scotland as the only published record is based on a misidentification.

The account by King (1917) corroborates some of the notes (Bland, 1999) on the biology of *betulae*. King found his specimens 'walking or resting among the lichens that covered the tree' and only a small number were under bark. They may have been feeding or seeking food when collected, which took place over a period of nearly three weeks between 21st July and 17th August. Perhaps the bugs only retreat under bark when not feeding or during cold and wet weather. He found them all on a single tree illustrating quite dramatically that these bark bugs tend to cluster. Encountering large numbers in this way may be explained by an observation by Massee (1960). He described seeing lots of a sibling species *A. depressus* (Fabr.) flying around recently felled oak and birch that were exuding sap. This could result in a population building up rapidly with subsequent generations remaining in *situ* while a food supply remains in a suitable condition.

In King's sample of *betulae* there is a roughly equal sex ratio between males and females and it is probable that none were in the process of mating. It is possible to suggest this because King was quite diligent in labelling insects found *in copula*; numerous examples are found so marked throughout his collection in all the various orders that he collected. Neither does he mention any mating process (King, 1917) which supports the probability that he did not observe it. Mating may occur at a different time of day or season. He did bring some individuals back alive to Glasgow where the nymphs became adult in September. The 6 cast nymphal skins of penultimate instars in the collection must represent these. There are a small number of whole nymphs; 2 penultimate, 6 antepenultimate and two more significantly smaller that may be of an earlier stage.

Oddly, the discovery of the most widely distributed bark bug of this genus in Britain, *A. depressus*, did not occur in Scotland until much later (Massee, 1964) in Tomich, Strath Glas, Inverness-shire. This species had been found also in the same year in Rannoch but was not announced until a decade later (Crowson, 1974). It has since been found twice elsewhere, at Fort Augustus, Glen Tariff, 30 May 1982 by I.M. White and Spey Bridge, 3 May 1981 by E.C. Pelham-Clinton, according to data on specimens in the National Museums of Scotland. So the first notice of finding *Aradus* bark bugs in Scotland can still be credited to King, as has been claimed (anon. 1926). The relative obscurity of provincial journals may explain how King's record evaded early attempts to synthesize geographical distribution as neither Butler (1923) nor Bedwell (1945) listed *corticalis* as being Scottish. Even when Massee (1955) did notice the record it was then rapidly queried (Southwood & Leston, 1959) but the specimens to unravel the story were not available until now.

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The stone loach in Orkney

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The stone loach *Barbatula barbatula* is a small freshwater fish rarely attaining a length of more than 10 cm. It is not only found in running water but also in lochs and is mainly nocturnal hiding during the day under stones or in dense weed. On mainland Scotland it has been recorded as far north as Loch Lomond in the west and the Aberdeen Dee in the east (P. Maitland pers. comm.).

While carrying out a survey in 1990 of nursery streams of brown trout *Salmo trutta* in Orkney, using electro-fishing, Douglas Sinclair found a well established population of stone loach in the burn of Hillside (HY320226) and its tributary the Burn of Lushan (HY336230) in the West Mainland of Orkney. This was the first reported record of this species in the county. He was also undertaking monthly gill netting of lochs: this included the Loch of Hundland (HY295260), into which these burns flow. At no time did he catch any stone loach, although they are not easily collected by (gill) nets but he did trap some three-spined sticklebacks *Gasterosteus aculeatus.* Since then, the stone loach appears to have extended its range. In 1997, while searching under stones in shallow water in the Loch of Hundland, 2 were caught using a hand net and 4 others seen. This was along a 20 metre stretch of the loch shore: the fish ranged in length from 2.5 to 8 cm. In the same year anglers reported discovering stone loach in the stomachs of brown trout caught in the loch. By 1999 it had spread, via a connecting burn, into the Loch of Boardhouse (HY270260).

It is not known how this fish came to be so much further north than its recorded range in Scotland but the most probable explanation would seem to be human introduction. The stone loach has apparently been in the Burn of Hillside since at least 1988 when, according to R. Andrew, it was seen during a field meeting of the junior Orkney Field Club, although not reported at the time. At present it seems to be thriving and it will be interesting to see if, in the future, it is found in burns and lochs elsewhere in Orkney.

I am very grateful to Professor Peter Maitland, of the Fish Conservation Centre, for information on the distribution of the stone loach in Scotland and to Douglas Sinclair for details of his survey findings.

Migrating river lampreys at the tidal weir, Glasgow

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Lampreys are primitive eel-like fish. The larval stages are blind and live in river sediments before metamorphosing into eyed adults which (usually) migrate to sea to feed and mature before returning to rivers to spawn and die. The adults have a mouth sucker armed with small teeth and feed on other fish - rasping the flesh and sucking blood.

Three species of lamprey occur within the Clyde basin area (Maitland, 1980a) and all are on the "Long List of globally threatened or declining species" (HMSO, 1995). These peculiar fish are rarely caught by anglers and sightings, especially of the sea-going species, are few and far between.

The largest species, the sea lamprey (*Petromyzon marinus*) is known to breed in the upper Leven and possibly the Clyde (Doughty, 1994,1996), whilst the river lamprey (*Lampetra fluviatilis*) has been recorded occasionally from rivers in Lanarkshire, Ayrshire, Renfrewshire, Kintyre and possibly Arran (Gibson, 1981 and *pers. comm.*) The population of river lampreys in the River Endrick has been studied by Maitland *et al.* (1983, 1994) and is unusual as the adults remain in freshwater, venturing only as far as Loch Lomond where they feed on powan (Maitland,1980b); Gibson & Mitchell, 1986). The brook lamprey (*Lampetra planeri*) which is very similar in appearance to the river lamprey, though usually smaller, is widespread in rivers and streams throughout the area but does not feed as an adult nor migrate to sea.

During routine trawling for flounder in the Clyde

Estuary at Bowling in January 2000, a small (14.5cm) recently matured, river lamprey was recovered by SEPA scientists. This was the first record of any lamprey in 20 years of trawl sampling in the Clyde Estuary by SEPA. In fact there are very few records of lampreys in marine waters of the Clyde area (Bagenal, 1965, Halliday 1969). By contrast, in the Forth Estuary, river lampreys are well known (Maitland *et al.*, 1984) and have regularly been captured in routine trawling surveys by SEPA (Elliott & Taylor, 1989). It is not known whether the Bowling individual was a vagrant from Loch Lomond or derives from populations within the Kelvin or Clyde catchments.

In Spring 2000, Caroline McGillivray, a student from Strathclyde University, undertaking a study of elver migration into the River Clyde (McGillivray,1999), captured some lampreys on the upper side of the tidal weir in Glasgow. (A few lampreys had been captured at the same locality in the Spring of 1999 and although tentatively identified as brook lampreys, this was not verified at the time and the lampreys were released).

The Spring 2000 elver sampling at the tidal weir took place at night in April and early May and the by-catch of lampreys were brought to SEPA for identification. On April 1st the first specimen, an adult river lamprey 25.5cm long, was recovered. Between April 18th and 20th four adult river lampreys were captured, two at 27.5cm and two at 30.5cm. One of each size was a gravid female indicating the lampreys were on route to spawning sites. A single brook lamprey (10.8 cm) was also captured on this occasion. Towards the end of the sampling period, three recently metamorphosed river lampreys were recovered, one on April 22nd and two on May 1st, with lengths of 10.5, 10.9, and 13cm. These were identified by the development of their teeth though distinguishing young river lampreys from brook lampreys remains difficult.

Records of river lampreys in the River Clyde system date back over 150 years. Patrick (1835,p.263) claimed "*the lampreys may be congregated in vast quantities by throwing a piece of carrion into the water*", while Clason (1836, p.448) noting the fish found in the Clyde and Calder says of the river lamprey (or "lamper-eel"); "*We should doubt its going down regularly to the sea, as it has many obstacles to encounter, which seem too great for it to overcome, yet it is by no means rare in these waters*". There do not appear to be any confirmed sightings for the Lanarkshire area, there do not appear to be any confirmed sightings since 1950 (Gibson, 1985). The new records are of interest as they verify that river lampreys continue to migrate up the estuary into the River Clyde system and it appears that recently metamorphosed river lampreys are also returning seawards.

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Large slow worm *Anguis fragilis* from Ailsa Craig, Ayrshire.

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Slow worms *Anguis fragilis* were known to inhabit Ailsa Craig from some of the earliest comments on the terrestrial fauna of the island. Lawson (1888) referred to them as "... *a curious denizen of the Craig*", and noted that they were "very abundant". But by the time of the second edition of his book (1895), during which period brown rats *Rattus norvegicus* had invaded the island (Campbell, 1892), the position had changed to the point where the human inhabitants of the island declared, when interviewed, that "*...they are almost exterminated. We think the rats must have done for them. A short while ago you could hardly turn over a stone without finding two or three under it - now you can scarcely find one.*"

Slow worms did however survive on Ailsa Craig. Leighton (1903) noted that J M Campbell had found specimens on Ailsa Craig measuring 18 inches long (457 mm). Gibson (1969) described them as fairly common but in thirty years had failed to find one above 14 inches long (355 mm). Anecdotally, Lawson (1888) had mentioned a slow worm measuring 21fi inches (546 mm) that had been caught on Ailsa but no competent naturalist had recorded the event.

Smith (1964) gave the length of the largest slow worms recorded in Britain as 460mm. Frazer (1983) noted that they commonly reached 400 mm in length but the largest recorded was by Fairfax (1965) who found a male specimen at Portsmouth, England, measuring 489 mm.

Since 1986 I have measured and weighed most of the slow worms found casually on Ailsa Craig and have accumulated over 50 records. In 1992 I caught a large example measuring 441 mm but this was superseded on 12 May 2000 when I caught a mating pair, the male of which measured 490 mm - a British record. It weighed 49 gms.

Following a major rat eradication campaign in spring 1991, and again in winter 1992, regular monitoring showed Ailsa Craig to be free of rats for the first time in over 100 years (Zonfrillo, in prep). The fact that this predator has been removed and, given that the main food of slow worms - slugs and snails - are abundant on Ailsa Craig, this may account for an increase in survival and therefore size of the slow worms on Ailsa Craig. Slow worms are long-lived and it remains to be seen if specimens the size of that recorded anecdotally in Lawson's time will be found in future on Ailsa Craig.

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Ravens nesting alongside the Dumbarton Boulevard

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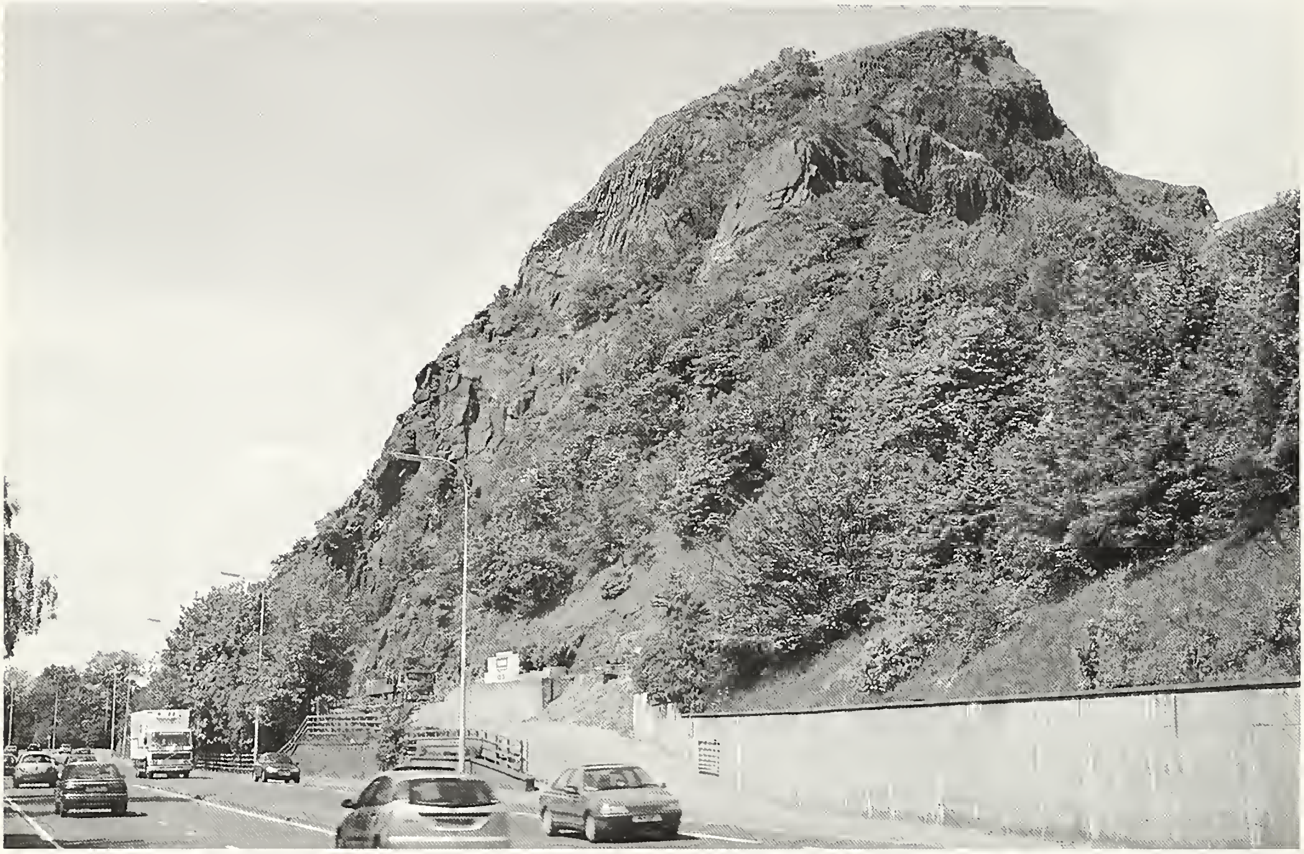
Ravens *Corvus corax* L. have taken a further step in the expansion of their breeding range in lowland Dunbartonshire, with the establishment of a nesting pair on the south side of the still worked Dumbuck Quarry, the occupied rock face directly overlooking the busy A82 (Fig. 1). Despite the quarrying activity and the almost constant flow of road traffic throughout the day, the birds have bred successfully at this site for at least four years (1997-2000). Dumbuck Quarry offers an exceptional opportunity for watching raven behaviour at the nest, as the unconcerned parent birds' comings and goings in spring can be readily observed with binoculars from the cycleway on the opposite side of the road.

It may be their offspring which have recently been seen displaying around Dumbarton Rock – less than 2 kms distant from the quarry. Unfortunately, the steepest faces below the castle fortifications are often used by rock climbers, the disturbance this creates probably sufficient to deter a second pair of ravens moving into Dumbarton's urban fringe.

Urban magpies and crows

Fig. 1. Raven nesting site overlooking Dumbarton's main thoroughfare



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These vigorous corvids get a bad press through increasing numbers while sometimes (especially magpies) predating nests and youngsters of other and declining species. They do seem to have increased in urban areas, though in the vicinity of Hyndland Court, Glasgow, G12 9NR, the immediately visible nesting numbers remain stable at one pair of each, temporarily increasing to about four of each from breeding, plus occasional visitors.

From time to time temporary social gatherings are seen. Presumably these gatherings are drawn from a limited nearby area and may perhaps be more representative of the general local population numbers. From 1982 to date I recorded the numbers seen at this address, including the maximum seen on any occasion each month corresponding to any such gatherings. The highest monthly count each year was compared with corresponding counts in other years in 5-year groups (three years for 1982-84) and tabulated, together with the mean of these annual maxima for each group (Table 1, next page).

These averages of highest counts of magpies increase over the period until the last decade of the 20th century when they remained stable. The largest gatherings of magpies seen numbered 15 (31 December 1992), 24 (19 September 1993), 12 (1 March 1996), and 22 (23 March 1999). The crows show a slower and less regular increase, with maximum gatherings of 12 (November 1986), 10 (2 February 1993), 12 (24 October 1995) and 10 (27 November 1996).

The gatherings recorded were those which I happen to have seen, obviously omitting any which took place when I was not there to notice. In this urban vicinity both species show a marked increase over the 18 year period, particularly magpies., This accords with long-term trends for Britain in surveys by the British Trust for Ornithology, as recently recorded by Glue (2000). If their numbers were determined mainly by availability of prey, the current decline of most small urban songbirds should have reduced the corvids. The increase in corvids presumably reflects increased availability of other foods (e.g. garbage, discarded food scraps), perhaps more nest sites as urban trees mature, and reduced levels of persecution since the end of World War II (Glue 2000).

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Magpie behaviour in Kelvingrove Park

Table. Maximum counts of magpies and crows seen from Hyndland Court 1982-1999

Period	Magpies (*Pica pica*)		Crows (*Corvus corone*)	
	Total of maxima	mean	Total of maxima	mean
1982-84	7*	2.3	6	2
1985-89	27	5.4	29	5.6
1990-94	59	11.8	24	4.8
1995-99	54	10.8	38	7.6

* Sum of highest counts in 1992 (=3), 1983 (=2), 1984 (=2)

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In common with others of the crow family, the magpie evokes mixed feelings: the story that it refused to go into the Ark with Noah and the other animals damned it in many peoples' eyes for it preferred instead to sit on top of the Ark and chatter and swear as the world drowned. The magpie dominates Kelvingrove, as at Spring 1999-2000 there are at least 15 birds. Their chattering is part of park life and they are a nuisance to everything else. Notable behaviour includes following squirrels around and digging up nuts that they have buried, immediately the squirrel's back is turned. Fighting between themselves and other birds is common: this was clearly illustrated in cruel incidents between the 6th – 7th April 1999. Fierce and sustained attacks were made by magpies on a single member of their species, culminating in an all out attack on the 7th. I was attracted to the duck pond area of Kelvingrove by screaming that early morning and found the single bird in a very bad way with the eye-lids half closed, downed on the park pathway. It was by then no longer able to fly and attempts to escape were thwarted by a group of magpies. Attack was constant and even when I stood by the injured bird, two magpies in particular still tried to get at it. The victim's submissive behaviour in no way saved it and I remained with the bird for as long as I could but it then tried to run along the path to cover and once again the assault began. The sequence of attacks ran from the pond down to the River Kelvin. It is not right to interfere in "nature's way" but this incident was as bad as I have ever seen. I was told by a young woman at the time, that she too had tried to help the badly mauled magpie at the start of the attacks on the 6th. It did not in the end prove possible to give the bird any real chance of survival and magpie remains were spotted in the Kelvin on the 9th at which time too the magpies involved in the assault were bitterly scolding me.

Magpie savagery continued a feature of parkland life with their taking on the many local gulls. The magpies also attack cats predating in the park: 21st March 2000 some 14 magpies cornered a cat in a tree near the fountain, the cat eventually fleeing to thick cover.

Magpies are now the principal birds of the parkland, much to the disadvantage it would seem of everything else: they are surprisingly vicious.

Great spotted woodpecker nest in Kelvingrove in 1999

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Woodpeckers first explored an ailing willow tree near the pedestrian bridge in Kelvingrove as a potential nest site in 1998. It was not used that year, but in May 1999, it was cleared out by the woodpeckers and a nest was soon active. Visited daily from the 1st to the 18th June it proved possible to observe the birds' nesting habits. The woodpeckers fed the nestlings during periods of observation at an average of 4 minute intervals: foraging trips varied slightly in time and it can be assumed reflected distance travelled to find food. Early morning observations revealed extensive nest cleaning and faecal matter was taken out from the nest and dropped by the woodpeckers in surrounding parkland and notably in the River Kelvin. Birds carried sizeable amounts of waste, including twiggy material from the hole.

The birds reacted very badly to the presence of larger birds, such as magpie, and either scolded or took such evasive action as to distract other birds from the nest hole. The birds' caution did not however stop a great tit actually entering their nest hole on the 4th June but it was quickly away again.

A woodpecker chick appeared at the nest hole from

8th June and its calling could be heard over 40 metres distance, even with traffic on Kelvinway. It seems that there was at one point more than one chick but it is likely that the young bird which eventually left the hole trampled its brethren to oblivion. So intent were the adult woodpeckers on attending their young that not even police activity and arrest of anti-social elements immediate to the nest site on 10th June disturbed nesting work.

From the 14th to the 15th June activity about the nest became frantic, the surviving young bird was stretching well out the hole and calling continuously. The adults went through elaborate calling and drumming behaviour, coupled to ignoring the calls of their youngster completely, from the 15th to the 17th June, when the nest was found deserted. One young bird got clear and was seen in the parkland on the 18th; only very limited attention was given by the adults and the youngster was mobbed on several occasions when alone by other birds, notably blackbird.

On the 22nd June the nest tree which had been upright at 08.00 hours was down by 12.45 having fallen to the riverside. Attempts were made to arrange for the cutting of the nesting hole area out from the trunk to record the nest properly, this failed due to unhelpful bureaucracy, thus losing nest fauna and any real evidence of family numbers. The chance to observe the woodpecker nest over a long period of time and to watch the birds' behaviour was a unique opportunity, most especially in that it seems to have been the first woodpecker nest in Kelvingrove in modern times. That the woodpecker activity about Kelvingrove was eventually compromised by a brutal spate of tree felling was a sad anti-climax to two years local woodpecker activity. The birds remain active along the Kelvin Valley into 2000 but their chances of nesting success is at the time of writing, May 2000, open to question.

Swans on the Forth and Clyde Canal

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Mute swans have a long and popular association with the Forth and Clyde Canal. A pair called 'Jock and Jeanie' were well known and loved during the 1930s in the Kilsyth area, where they regularly took food from the passengers of the pleasure steamer 'Gipsy Queen'.

Today the canal still provides good habitat for swans both for breeding and for overwintering.

Table 1 shows breeding activity I have observed from 1998-2000 along the 16km (10 mile) stretch of canal from Kirkintilloch to the Lanarkshire County Boundary near the A80. Six pairs hatched 32 cygnets along this stretch in 1999. Each pair occupied a territory of approximately 1.5 to 3km (1 to 2 miles). The 'early birds' that hatched broods in May had bigger broods and kept more cygnets alive until the end of the year. The later pairs that hatched their broods in late June or early July were far less successful. They had smaller broods and only one cygnet was seen by December.

According to Gibson (1999), seven pairs raised fifteen young on the 14km (9mile) western end of the canal between Bowling and the Kelvin and a further pair raised five young between Bishopbriggs and Kirkintilloch in 1998. Including uncounted sections of the canal, it is therefore likely that around 16 breeding pairs exist on the canal within the Clyde area and around 20 breeding pairs on the canal as a whole. This may be compared with 127 breeding pairs for the entire Clyde area as given by Gibson.

Table 2 shows the winter flock size I have observed at Kirkintilloch over the 1999/2000 winter. The birds are very popular and fed frequently by the public. Other winter flocks have been recorded; Henty (1999) reports 39 being seen in the Falkirk area on the 11th March 1998. The winter flocks appear to be mainly incoming birds as the resident birds and their cygnets were often found on their territories during the winter. Taking resident and visiting birds together it seems likely that about 150 to 200 swans are present on the canal during the winter. This may be compared with a winter total of 3750 birds, as given by Thom (1986) for Scotland as a whole.

Table 2 Winter flock size at Kirkintilloch

Date	Flock Size
November 16, 1999	38
December 29 1999	48
January 18, 2000	52
February 5, 2000	34
March 11, 2000	22
April 9, 2000	6

To date (July 2000), the resident pairs are nesting again on the Kirkintilloch to A80 stretch and have produced 32 cygnets. Whilst the Millenium Link construction work may have caused problems for some swans within Glasgow and Falkirk, the descendants of 'Jock and Jeanie' will soon be greeting passengers on the new generation of canal cruisers.

Table 1 Breeding swans, brood size

Territory (one pair per territory)	Length (km)	1998 Summer	1999 Summer	When hatched	1999 Winter	2000 Summer
Kirkintilloch to Tintock	2.3	Not checked	6	Early	8 to 12 *	3+4[1]
Tintock to Twechar	2.4	Vacant	3	Late	None	4
Twechar to Auchinstarry	2.6	6	Vacant	-	-	3
Auchinstarry to Craigmarloch	2.9	7	9	Early	8	3
Craigmarloch to Kelvinhead	2.1	3	2	Late	1	3
Kelvinhead to Wyndford	2.0	5	8	Early	2	8
Wyndford to A80	1.4	2	4	Late	Vacant	None
Totals	15.7	23	32	-	-	28

* includes winter visitors

[1] two pairs occupying territory

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Further confirmation of the presence of Sika deer on Loch Lomondside

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During a visit to the head of Gleann nan Caorrunn with Tim Jacobs on 27th July 1999, a herd of red deer *Cervus elephus* was observed moving across the south face of Ben Lui. From the group could be heard the distinctive whistling call of Sika deer *C. nippon*, although because of the distance it was not possible to determine if more than one animal was involved. Sika deer have previously been reported on Loch Lomondside in the Tarbet and Inversnaid areas (Mitchell, 1985; Trubridge, 1990).

As this introduced Japanese species continues to extend its range in Scotland, instances of inter-breeding with the larger red deer are well documented (Ratcliffe, 1987). Taking a pessimistic view, the long-term future of red deer – Britain's last great land mammal – appears to hang in the balance from introgressive hybridisation with Sika; perhaps eventually with the pure blood line preserved only on some of the isolated Scottish islands such as Rum.

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Roy Albert Crowson D.Sc., A.R.C.S., D.I.C.

Roy Crowson, who died on May 13, 1999, aged 84, was one of the most distinguished systematic coleopterists of his generation, his interest being fired by gifts of a book on beetles and a copy of Darwin's *Origin of Species* during his childhood. His enthusiasm was maintained to the end though he admitted that if he had not chosen beetles he would have selected some other group for study.

A native of Kent, he retained his regional accent throughout his life and, after graduating from the Imperial College of Science and Technology in London he was appointed assistant curator at the Tunbridge Wells Museum. He served in the RAF during the 1939-45 war and came to Scotland in 1948 to take up a lectureship in Taxonomy at the Zoology Department at Glasgow University. Subsequently he was promoted to Senior Lecturer and, after reaching retiring age, stayed on as an Honorary Lecturer and Research Fellow until his final illness struck.

In 1954 he married Betty Campbell, a Glasgow graduate with a keen interest in spiders, and she remained a stalwart companion throughout his life looking after him and collaborating and contributing to his work both at home and abroad.

His published works, totalling over 200, covered many aspects of his subject. Early in his career (1950-54) he produced a series of papers in the *Entomologist's Monthly Magazine* detailing an evolutionary system of classifying the families of British Coleoptera. A revised version of this with the title, *The Natural Classification of the Families of Coleoptera*, was published in 1955 and this was reprinted with additions and corrections in 1967. The arrangement of the major groups in this latter work was largely followed in the most recent check-list of British Coleoptera (1977). A review entitled *The phylogeny of Coleoptera* appears in the *Annual Review of Entomology* in 1960 and a paper entitled *The evolutionary history of Coleoptera, as documented by fossil and comparative evidence* appeared in 1975. His magnum opus the monumental book, *The Biology of Coleoptera*, was published in 1981.

Roy was an ardent Darwinist and had a rare, computer-like capacity to see his subject as an integrated whole rather than as a series of parts. This ability was by no means confined to beetles: he could also discuss subjects as remote as the origin of fishes and the evolution of their swim bladder with authority. I suspect he was not much interested in species taxonomy, though he contributed to numerous faunal surveys, but seemed more interested in the inter-relationships of groups and their adaptive radiations. One of his main natural history interests was the recognition of key species of beetles as indicators of ancient woodlands and he collaborated with other Glasgow Natural History Society members, the Nature Conservancy Council and the Scottish Wildlife Trust in studies of these.

His erudition was overwhelming and, with an exceptional memory for detail, he could be a formidable opponent in argument. With little interest in small talk and none in gossip he rarely relaxed. The only memory of my 23rd birthday tea in 1948, was his telling me that the genus *Rhododendron* had more than 500 species! Like many distinguished scholars, he did not suffer fools gladly and eschewed pretentiousness or humbug. At times he could become emotionally involved in the defence of his views and a well-intentioned, but misjudged lecture held recently in his honour, purporting to be about "Fields and Trees" but really dealing with computer-generated dendrograms, was received with less than enthusiasm.

At the Zoology Department Roy made countless preparations for anatomical investigation and in his room a bunsen burner flamed continually, like a ritual candle, in readiness to macerate dissected beetle parts in hot caustic. From these he built up an extensive and valuable collection of carefully prepared microscope slides. He also left extensive spirit collections of beetle larvae and, as one of the curators of the Zoology collection of the Hunterian Museum he looked after and extended the collections of pinned insects. He recorded his findings immediately, touch typing with furious abandon.

In the field he worked relentlessly and with great energy and this vigour was apparent elsewhere. He talked rapidly, walked more quickly than most people and until he was well into his sixties travelled to work on a small-wheeled bicycle.

It would be a mistake, however, to think that Roy's life was entirely dominated by beetles and Zoology. He read widely, could quote much poetry from memory and could hold his own in philosophical argument. He was a passionate lover of classical music, in particular that of Mozart, whose works he knew by their Kochel numers, and of Handel, Elgar and Bruckner. He was also an accomplished, self-taught pianist. He was an excellent linguist being fluent in French, German and Russian and did much to draw attention to the works of Russian entomologists.

In 1980 Roy was awarded the gold medal of the Linnean Society in recognition of his unique contribution to Entomology, and in 1994 a two-volume *Festschrift*, or celebratory collection of papers entitled *Biology, Phylogeny and Classification of Coleoptera* was published in Warsaw to commemorate his 80th birthday. It is regrettable that the University which he served so long and so well did little to acknowledge his contribution – a personal professorship was the least that might have been expected.

Ronald M. Dobson

Roy Crowson (1914-1999): a tribute

This tribute records two encounters, separated by about 34 years, indirectly involving Roy Crowson.

The first encounter, when as a new lecturer I first discovered Roy, took place at a Friday Genetics Department seminar in March 1960. It can be dated precisely because I was to be married the next day and, following customary teatime entertainment, the departmental staff and research students were in an unusually high-spirited mood. The seminar itself was given by an American visitor, Dr Charles Sibley, later to be celebrated for his DNA-DNA hybridisation studies of bird phylogeny. On this occasion, Dr Sibley described the use of egg-white protein electrophoresis as a taxonomic tool. The talk was followed by a lively and (to us) amusing discussion led by inimitably challenging remarks from Dr Crowson, who clearly thought the method controversial. As I now know, he was right to be so sceptical. But then, he was certainly the only listener who thoroughly understood the issues.

The second encounter had three parts: a foundation, a passing remark and an eye-opening revelation. The foundation lay in serendipitous events of the 1980's that led my research into molecular systematics. The passing remark, made to Roy years later, was that I had never actually read his book *Classification and Biology* (Crowson,1970). (It was meant as a shame-faced admission, but may have sounded inappropriately triumphal at the time.) The eye-opening revelation came when I did read the book.

What I found was that most of *Classification and Biology* remains as cogent today as it was in 1970 and that much of it was incredibly far-seeing. Only recently has it become widely recognised that human influence on the biosphere is causing catastrophic loss of biodiversity and that the national and international neglect of taxonomy education and research has undermined the ability to recognise and record what remains and what is lost. But this was plainly emphasized. Was phylogeny (i.e. genealogy) or numerical taxonomy (i.e. phenetics) to be the way forward for classification? At a time when phenetics was new and highly fashionable, Roy sided strongly with Darwin—classification must be genealogical. Moreover, he declared that it should proceed on then newly-recognized Hennigian principles.

What is the role of fossils in systematics? In Roy's book you will find a valuable discussion of this oft-neglected question. What about the microbes, especially bacteria? In *Classification and Biology* Crowson pointed clearly to the future role of DNA-based systematics which, in the last few years, has started to rescue bacteriology from its prolonged Dark Age.

What does a taxonomist actually do? No other author, as far as I am aware, has ever provided a thumbnail sketch of a taxonomic "system of work". What is the relationship between taxonomy and nomenclature? Issues that are urgently re-addressed in the present era of cladistics and molecular phylogenetics are here aired and clearly analysed. Can the computer replace the taxonomist? Of course not! and cogent reasons are given. What is the future of systematics and will taxonomy be restored to its central position in academic biology? A vital question! In today's climate of retrenchment the answer is "Probably not", but at least the central position and past neglect of taxonomy are now widely recognized and a little redress has been attempted, exemplified in Glasgow University by the creation of a Taxonomy lectureship and success in the NERC Taxonomy Initiative.

In short, I found Roy's book to be a neglected masterpiece, ahead of its time and far-seeing beyond expectation. If Glasgow University is to some extent a sleeping giant, perhaps that reflects its (erstwhile?) slowness to appreciate, cherish and suitably reward its most talented staff who, like Roy, may have to receive their most timely and greatest recognition from the outside world.

Reference

Crowson, R. A., (1970). *Classification and Biology*. Heinemann, London.

Bernard L. Cohen

BOOK REVIEWS

Compiled by RUTH DOBSON

Kibble's Palace

ERIC W. CURTIS

Argyll Publishing, Glendaruel, 1999, 87 pp., softback with black and white photographs and colour plates and line drawings. ISBN 1 902831 04 7, £7.99.

One has only to glance at the numerous sources listed in "Acknowledgements" to appreciate the amount of research that has gone into the production of this book. Eric Curtis, former Curator of the Botanic Gardens has unearthed the fascinating history of the Palace and its original owner, John Kibble. The story of its construction on the shores of Loch Long and subsequent dismantling and transportation by ship to Port Glasgow and thence to the Botanic Garden, is probably known to few of its visitors. At first intended for use as a venue for concerts and lectures, its acoustics were not satisfactory, and its most successful function has always been as a plant house. It has hosted an amazing variety of gatherings, including the installation of Disraeli as Rector of Glasgow University, the Rectorial Address of Gladstone, meetings of the evangelists Moods and Sankey and the largest charity bazaar ever held in Scotland at that time.

In spite of its magnificence, the Palace has not always been properly maintained, but has from time to time been rescued by renovation work. At present Glasgow City Council have applied for a Heritage Lottery Grant of £2,000,000 towards its complete refurbishment.

The book contains illustrations of other nineteenth century curvilinear glasshouses which allows us to compare these structures with the Kibble Palace - I would suggest probably in its favour!

Edna Stewart

Fossils Illustrated: Plant Fossils

CHRISTOPHER J. CLEAL & BARRY J. THOMAS

The Boydell Press, Woodbridge, 1999, 188 pp., which include 41 text-figures of plant reconstructions; also 128 black and white plates mainly of fossils but also with some reconstructions. ISBN 0 85115 684 3, £60.00.

Written by two very well qualified authors, this is the third volume in a series on fossils. Many, but by no means all, of the illustrated specimens are housed in the National Museums and Galleries in Cardiff, Wales. The book deals with the remains of plants from the Silurian period, about 425 million years ago, right up to the Holocene, the present interglacial period covering the last 11,000 years or so. There are ten chapters, two appendices and explanations of the plates.

The principal point of the series is, of course, to illustrate fossils. Fossils of plants in hard rock and thin sections of fossil plants are by no means the easiest subjects to photograph and to make into exciting objects. The quality of some of the plates is good or very good but there is something unsatisfying about many of them which is hard to describe. The best I can do is to say that the greyness and blackness is off-putting and one does not feel any strong desire to flick through the pages to see what splendid image will be next. Plate 26 shows six of the stumps of the world-renowned Fossil Grove here in Glasgow. These trees had been growing some 325 million years ago in the Lower Carboniferous period. The photograph inspires little sense of wonder. Plate 103 shows house walls made by the local Red Indians from parts of the abundant fossil logs scattered in the Petrified Forest National Park in Arizona. There are many very eye-catching images published elsewhere of these strikingly colourful fossils; one such log, cut transversely and beautifully polished can be seen in the Hunterian Museum of Glasgow University. These two plates strike me as typical of the unfortunate dullness of many more. The blackness of the hard cover and of the dust jacket does nothing to dispel the somewhat dreary impression.

Keen palaeontologists may wish to add this volume to their libraries but it is hard to see the run of the mill naturalist wishing to spend £60.00, which even today is quite a large sum.

Jim Dickson

Island Biogeography: ecology, evolution and conservation

ROBERT J. WHITTAKER

Oxford University Press, Oxford, 1998, 285 pp. Illustrations black and white photographs and diagrams. ISBN 0 19 850021 1 (Hbk), £50.00; 0 19 8500203 (Pbk), £19.99.

This book, aimed at advanced undergraduates and postgraduates in geography and the life sciences, is a conscious attempt to update the previous synthesis of the subject, Mark Williamson's Island Populations of 1981. With a reference list of over 600 papers and books, the vast majority of them from post 1981, the author certainly succeeds in bringing the reader up to date.

Since the time of Darwin and Wallace, islands have had a special importance in the development of evolutionary and ecological ideas: they have often been the source of 'natural' experiments, where the appearance of a new island or the volcanic destruction of the biota of an existing island, allow us to observe the pattern of new colonisation and the evolutionary shifts that result from novel species assemblages interacting in a new habitat. The author's own research has largely derived from the most famous example of island volcanic sterilisation, the eruption of Krakatau.

Chapter one sets the scene and reminds us of the practical problems of island conservation. Chapter two defines what islands are and provides a classification of island types in terms of size, remoteness, geology, climate and longevity. Although it is possible to think of a desert oasis as an island, the author has decided to stick to land islands surrounded by sea. Chapter three discusses islands as biodiversity hot-spots: although islands tend to be impoverished in species numbers, they are very high in numbers of endemics. However, the historical impact of humans is such that all island faunas and floras are already relicts of what they were.

Chapters four to eight get down to details of island ecology and evolution, reviewing a hugh number of recent studies both practical and theoretical. I found many fascinating examples here which will find their way eventually into lecture notes.

The book ends with two chapters on conservation: do theories of island ecology have general relevance in conservation biology? And what are the special problems of the conservation of island biota?

The book is well written in the style of an extended discussion, constantly debating what any new study has shown and how well our theoretical models are supported by real evidence. The level is well aimed at senior undergraduate or postgraduate students: I suspect that the interested general reader will find the book tough going. As minor criticism, I found that some of the diagrams were inadequately explained and some of the many technical terms not defined. A glossary would have been helpful. The book is good value at the paperback price.

J.R. Downie

Ireland: a survey of Irish Natural History (The New Naturalist Library)

DAVID CABOT

Harper Collins Publishers, London 1999. 512 pp., softback with 8 colour plates and over 230 black and white photographs and line drawings, maps and tables. ISBN 0 00 220080 5, Hardback £34.99; Paperback £17.99.

The book is a detailed exploration of the biology, climatology and geology of Ireland. It is a real adventure in natural history and is beautifully illustrated with black and white and colour photographs. The art work is in general very pleasing, providing a respite from the remarkable textual mass of information. It cannot be said to be easy going but is in the long run very rewarding. A 27 page bibliography linking in to the chapters provides opportunity to explore further the many aspects of Irish natural history. Perhaps that is the real problem, for there is so much that Cabot's enterprise can only be a taster.

Personally there is a disappointment, the chapter on naturalists and their work. The usual naturalists are highlighted; the work of Praeger and Templeton can never be under-estimated nor the role of the Victorian Natural History Clubs. But there are omissions with brief reference only to A.W. Stelfox and none to his wife Margarita Dawson Stelfox, nee Mitchell: two very important Irish naturalists. Together they first confirmed *Diderama lucidum* in Ireland, on wet moss at the Dargle waterfall, Powerscourt, in 1925. Mrs Stelfox was of particular note for her National Programme of Rural Science or Nature Study, a first step in primary school science in the 1920s. Her contribution to Irish myxomycete flora was also important.

It is a pity too that the foot soldiers of 20th century Irish natural history are passed by; for example Mary P.H. Kertland's role in natural history and especially her editorship of the Irish Naturalists' Journal; John McK Moon's contribution to Irish fungi; S.T.S. Skillen and others' work on Irish bats; to mention but a few. Family values make me raise such issues of Irish naturalists but in doing so it really underlines Cabot's contribution. Cabot has built a story from a mass of information and his contribution is to open up the real Ireland, not the one of war and words, thereby to encourage others to explore the natural history of Ireland. Perhaps too, to come to know its forgotten naturalists and their very important role in Irish history.

Brian S. Skillen

The Sun Islands: A Natural History of the Isles of Scilly

PATRICK COULCHER

The Book Guild, Lewes, E. Sussex 1999, 166 pp., hardback with 66 Colour Plates, Maps and Line Drawings. ISBN 1 85776 348 3, £17.75.

After an introductory chapter about the history of the whole group, the chapters are devoted to descriptions of each island, concentrating mainly on matters of natural history interest but also describing the scenery and the way of life.

The header to each chapter is an attractive line drawing and there is a simple map showing the places mentioned in the text. The names of plants and animals are given in English and printed in italics, which makes them easy to pick out if skimming for information. The appendix contains a comprehensive bird check list and a list of the latin names of those plants mentioned in the text.

The plates are mainly photographs by the author and are bound together in the centre of the book. There is a good mixture of scenery, bird, insect and plant material. The enthusiasm of the author would encourage any natural historian to go to these islands and the book would be an excellent read before, during and after a visit.

Jean M. Millar

The Biology of Lakes and Ponds

CHRISTER BRÖNMARK & LARS-ANDERS HANSSON

Oxford University Press, Oxford, 1998, 216 pp., graphs, diagrams and line drawings. ISBN 0 19 854972 5 (hardback), £51; 0 19 854971 7 (paperback), £19.50.

As one might expect from writers with the eminent research background of the authors of this book, this is a scientifically sound and erudite but also a highly accessible introduction to the biology of lakes and ponds. The third volume in the Oxford University Press "Biology of Habitats" series to deal with an aquatic habitat, this volume is clearly aimed at senior secondary school to undergraduate biology students. There is of course a multitude of books on the biology of lakes - what makes this book any different from the others? Well firstly it is the stated aim of this volume to focus not on the classical aspects of limnology, namely the role of the environment in shaping the plant and animal communities, but on the effect of the biotic interactions between individuals, populations and species, in freshwater lake communities. Thus two chapters are devoted to competition, predation, parasitism, symbiosis and food web interactions. The abiotic framework within which animals and plants live is not completely ignored however, with a chapter devoted to the effects of light, buoyancy, temperature and nutrients. A fourth chapter gives a very quick scamper through the main plant and animal groups which, although necessary in a volume clearly intended to provide a complete course text for the field, is so short that it never achieves any depth. A final chapter examines four of man's less positive effects on lakes: eutrophication, acidification, new species introductions and the effect of UV radiation. As with the chapter on plants and animals, I was left feeling that these topics did not get the attention that they deserved and that perhaps this would have been better dealt with elsewhere.

Despite these minor reservations, the clear orientation of the text towards students, the inclusion of practical exercises presented at the end of each chapter, the use of text highlighting to focus on important definitions and the "lecture note" format mean that this is clearly a book that will be bought by teachers and students and will certainly be the preferred teaching text for some years to come.

Colin E. Adams

The Biology of Streams and Rivers

PAUL S. GILLER & BJÖRN MALMQVIST

Oxford University Press, Oxford, 1988, 296 pp., softback with line drawings, diagrams, graphs and tables. ISBN 0 19 854977 6, £19.50.

This is one of the OUP's 'Biology of Habitats' series of books which are intended to provide students, naturalists and researchers new to the field with an overview of the biology of organisms in given habitats. The authors' aim is to produce a broad, up-to-date introduction to river and stream biology in a single, relatively slim volume. They make a worthy effort to illustrate their points with examples from lotic systems world-wide, although as they acknowledge, this is not always easy as most research has been carried out on northern temperate waters. The authors also readily admit to a bias in favour of freshwater invertebrates, the subject of much of their own research.

The first three chapters describe the unique nature of lotic habitats, the particular characteristics of different types of running waters (ranging from trickles running over rock faces to large rivers) and go on to cover the physical, chemical and biotic features which influence the biota. Subsequent chapters describe the types of organisms found, their adaptations to life in lotic habitats, nutrients and energy flow, colonisation, species interactions, species diversity and patterns at the community and biogeographical scales. The final chapter is concerned with the uses of running waters, pollution and conservation.

The obvious drawback with a text such as this which attempts to be all-embracing is that inevitably, some topics are covered superficially. However, the authors partly compensate by providing an ample, up-to-date list of almost 600 references, about half of which relate to publications which are less than 10 years old. They also provide suggestions for practical studies of a type suitable for student honours or sixth year studies projects.

I would strongly recommend this well-structured and accessible book to undergraduate students of freshwater biology both as an introductory text and as a signpost to other more in-depth studies.

Ross Doughty

Urban Habitats

C. PHILIP WHEATER

Routledge, London, 1999, 188 pp., paperback with numerous line drawings, diagrams and maps, and 4 pages of colour plates. ISBN 0 415 16265 3, £15.99.

Most readers of the Glasgow Naturalist will not need to be convinced that urban habitats are not only important for wildlife but are worthy of conservation and proper management. This book is an excellent guide to the flora and fauna inhabiting urban habitats and the kinds of practical management they require. There are case studies from around the UK and of local interest is that of the Forth and Clyde Canal in Glasgow.

This book is well written and essential for anyone involved in local conservation issues. The author has produced a book which has filled a much needed gap and is thus to be congratulated.

Bernard Zonfrillo

Woodland Habitats

HELEN J. READ & MARK FRATER

Routledge, London, 1999, 177 pp., colour and black and white photographs, line drawings, glossary and bibliography. ISBN 0 415 18090 2, softback £15.99, hardback £50.00.

This is one of the first in a new series describing different habitat types in Britain. Following a historical review of woodland and its use in this country, the main part of the book deals with woodland ecology, management and conservation, concluding with case studies and suggestions for practical work. Although not stated specifically, the inclusion of this last section suggests the series is aimed at senior school students.

Written in a clear and non-technical style, the work is a useful introduction to its chosen subject. One criticism from the Scottish perspective however, is the over emphasis on woodland in the southern half of Britain. Buying the book yourself or dropping a hint to somebody else for your Christmas stocking, make sure to ask for the paperback version which is reasonably priced - the hardback by comparison costs a king's ransom.

John Mitchell

Marine Nature Conservation Review, Sector 12: Sealochs in the Clyde Sea Area: area summaries.

F.A. DIPPER & R. BEAVER

Joint Nature Conservation Committee, Peterborough, 1999, 96 pp., A4 paperback with numerous maps. ISBN 1 86107 467 0, £30.

This is one of a series of reports produced by the Marine Nature Conservation Review of Great Britain (MNCR) which operates under the Joint Nature Conservation Committee. The MNCR was initiated by the Nature Conservancy Council in 1987 with the objectives of extending knowledge of seabed habitats, communities and organisms and identifying sites of nature conservation importance within the coastal waters of Great Britain.

This publication summarises the results of several field surveys of the shores and sublittoral zones of sea-lochs in the Clyde Sea Area undertaken by various organisations, but predominantly by the University Marine Biological Station, Millport. All the sea-lochs, from Loch Ryan in the south to Gareloch in the north, are represented and are split into seven geographical sub-areas. The bulk of the book consists of separate accounts of these sub-areas, each of which, with one exception, includes very clear, well-designed maps showing survey sites and the distribution of the main habitats (the latter colour-coded), a detailed description of the habitats and their fauna and flora, a survey of human influences and a list of references and further reading relevant to that sub-area. The exception is the account of sub-area 7 - Campbeltown Loch, which, since the loch has never been surveyed, is very sparse and contains no information on habitats or organisms. Amongst the appendices is a helpful list of all species recorded in the main surveys and their occurrence in the six sub-areas that have been examined properly.

It is apparent from the information in a leaflet accompanying the book that it is intended to be a reference source primarily 'for marine scientists, marine biological surveyors, environmental planners, regulators, consultants and conservation managers'. However, amateur naturalists interested in matters marine should not be put off by this because, by virtue of its excellent cartography and highly readable text, it provides an accessible and exhilarating insight into the diverse habitats and faunal richness of our local fjords. Inevitably there is a plethora of Latin binomials, but any problems caused by this could be overcome by reference to one of the well-illustrated sea-shore guides that are available currently.

Iain C. Wilkie

R.S.P.C.A. Guide to Garden Wildlife

VAL PORTER

Harper Collin, London, 1999. Softback profusely illustrated in colour. ISBN 0 00 413383 8, £7.99.

This is an attractively produced book that should appeal to the general reader and in particular to families whose younger members will enjoy identifying the species seen in gardens from the many clear and well presented illustrations.

The introductory chapter deals with the many ways in which wildlife can be attracted to a garden no matter what its size, while also making the reader aware of the many drawbacks that can be encountered. The following chapters include one on creating a garden pond while the others deal with the many species which may be found in a British garden, though here some distribution maps would be useful. Throughout, the text gives details of the habits and lifestyles of those species and never fails to point out the various hazards that can be encountered by wildlife and humans alike which may arise from human ignorance or thoughtlessness. Eye catching tramlines have been drawn around parts of the text to highlight problems or information of particular importance or interest and each piece of text is clearly entitled. The book puts equal emphasis on all species associated with gardens and encourages the reader not to be too selective in encouraging species but rather to create a haven whereby many species can find congenial conditions. The suggestion that 'the ideal wildlife garden probably belongs to a lazy gardener', appealed to me greatly.

This is a thoughtfully presented book and should be of interest even to those without gardens and, at £7.99, is excellent value for money.

Joyce Alexander

Top Wildlife Spots: the best 200 places to see wildlife in the UK

GEOFFREY YOUNG

Harper Collins, London, 1999, 256 pp., softback with numerous diagrammatic maps. ISBN 0 00 220178 X, £6.99.

This is a very comprehensive guide to the "best" of the Wildlife Trusts' Reserves throughout the UK. However, the cover title can be misleading, since it only deals with the best of the Wildlife Trusts' Reserves. Since there are proportionally less Wildlife Trusts' Reserves in Scotland - only 12 reserves mentioned - it would be a more useful book to help plan a holiday or a weekend south of the border. The introduction explains about nature reserves and conservation action taken at the different habitats on the reserves. The book is set out well and easy to use with a map at the beginning of each "region", showing the location of the reserves. A page is taken for each reserve with a diagrammatic map of the reserve, brief description, Ordnance Survey map reference, useful information on the reserve e.g. car parking, opening times etc., and a description of the wildlife features with quick picture references on the top right hand side. For £6.99 the book is excellent value, covering a lot of information on the reserves.

Kirsty Kennedy

Field Flora of the British Isles

CLIVE STACE

Cambridge University Press, Cambridge, 1999, 736 pp., softback with a few drawings and photographs. ISBN 0 521 6531 0, £17.95.

Based on the now standard British Flora by the same author (1997 2nd edition) this compact version provides the same comprehensive coverage of the wild plants (including grasses and sedges) which might be expected to be found during field excursions. In order to provide such a full coverage, a number of illustrations and species descriptions have been omitted, but full keys have been retained, supplemented by brief distribution and habitat data. There is a short general introduction and the illustrated glossary is retained, with an index providing generic and common names only.

The book is definitely not for the beginner and some of the long keys will prove troubling even to an experienced botanist; common native species may be 'hidden' among the large number of aliens and non-local British natives. However, short of the bulky full Flora, this is the only work available that can be reliably taken into the field. Some of the more popular colourful field guides will make useful companions to this book and arguably, as with the full Flora, it is a useful first stop when trying to work out puzzling plants from weedy localities overseas. The book is very portable, with a protective plastic cover, packed with information and represents excellent value for money.

Keith Watson

Insects of Britain and Europe (Collins Wild Guide)

BOB GIBBONS

Harper Collins, London, 1999, 255 pp., softback with 239 colour photographs and numerous line drawings. ISBN 0 00 220134 8, £6.99.

After a brief introduction, this pocket-sized book presents colour photographs of 215 species of insect, 15 spiders, 2 harvestmen, 2 centipedes, 2 woodlice, 1 millipede, 1 tick and 1 mite with concise details on their biology and distribution together with notes on similar species. In format and coverage it closely resembles Sandhall's *Smakryp* (Bonnier, 1973) and its English adaptation Insects and other *Invertebrates in Colour* (Lutterworth Press, 1975) even to the extent that 91 species are common to both books.

Most of the species included are large and conspicuous but not necessarily common. 19 do not occur in Britain and over 50 are rare or southerly species. Lepidoptera have been deliberately excluded but Odonata, Orthoptera, Hemiptera, Diptera and Coleoptera are well represented. Most of the photographs and drawings are good and the notes are adequate. The bibliography is meagre.

Though far from "essential", as claimed by the publishers, this book could help stimulate interest in non-lepidopteran species and may be welcomed by those requiring a handy introduction to these.

Ronald M. Dobson

British Dixidae (meniscus midges) and Thaumaleidae (trickle midges): keys with ecological notes

R.H.L. DISNEY

Freshwater Biological Association, Scientific Publication No. 56, Ambleside, 1999, 128 pp., softback with line drawings and photographs. ISBN 0 900386 60 6, ISSN 0367 1887, £16.00.

This is an update of an earlier key (1975) to the meniscus midges with the addition of the small group of trickle midges. With the extensive biological information complementing the identification keys, this work provides a comprehensive account of the two families. All stages of the life cycle are discussed including eggs and pupae, with keys to larvae as well as adults. A species recently discovered in Britain, *Dixella graeca* (Pandazis), is added. The earlier key stimulated some interest in the meniscus midges, allowing them to be more authoritatively treated. All three of the trickle midges are known to occur in Scotland but the details appear to have been seldom investigated. This book should remedy this situation by providing the means for study, there being no excuse that the organisms cannot be identified. Henry Disney writes clearly and authoritatively using the first person, which helps to differentiate his own ideas and observations, most of which are new, without the normal convoluted prose needed to render these less personal. This latest addition to the Freshwater Biological Association Scientific Publication series provides another valuable tool for those interested in freshwater habitats.

E.G. Hancock

Provisional Atlas of the Longhorn Beetles (Coleoptera, Cerambycidae) of Britain

P.F.G. TWINN & P.T. HARDING

Biological Records Centre. Huntingdon, 1999, 96pp., softback with distribution maps for each species. £5 including p&p from Institute of Terrestrial Ecology. Publication Sales Section, Monkswood, Abbots Ripton, Huntingdon Cambridgeshire, PE17 2LS.

The cerambycid beetles (longhorns) are of considerable interest in nature conservation terms. This is because their larvae develop inside the timber of trees, be it dead or living, in small twigs or the main trunk. The most important terrestrial habitats in almost any part of the world are woodlands and assessing the biological value of a stand of trees and the diversity of life associated with it involves entomologists to a considerable extent. Indeed the value of trees to insects is greater than any other resource on which they might rely for sustenance. Evaluating wooded sites for their intrinsic worth or potential for conservation measures will inevitably turn up a longhorn or two. This is where this booklet becomes invaluable as this ongoing series of 'Provisional Atlases' now includes much more than just maps. There is an updated checklist, with identification sources and nomenclatural notes, as well as information on status and biology accompanying each species' account. Thus in the Red Data Book categories one learns that there are 17 notables (A & B), 6 RDB3, 2 RDB2 and 2 RDB1 species in this one family. Out of a total of 59 species that are eligible for RDB status (the others are either extinct or regarded as of non-native origin) this is remarkably high. It is indicative of the precarious hold that saproxylic insects have in British woodlands, threatened constantly with felling, grazing and other forms of unsympathetic management. So this latest production is going to be greatly useful in such studies. Perhaps the series should be re-titled to reflect their true content.

E.G. Hancock

Collins Bird Guide

KILLIAN MULLARNEY, LARS SVENSSON, DAN ZETTERSTROM & PETER J. GRANT

Harper Collins, London, 1999. 392 pp., plus index, hardback with several coloured illustrations of every species. ISBN 0 00 219728 6, £24.99.

In recent years I have repeatedly criticised new field guides for being of little practical use - one in particular had only adult male birds in summer plumage illustrated. This new guide on the other hand is the complete antithesis. Not only are a wide variety of plumages illustrated for most species and sexes, but the text notes and annotated illustrations combine to give the precise kind of information required to identify even the most tricky and confusing of species.

The artwork is of a high standard and the distribution maps are colour coded to show winter and summer distribution. Perhaps if a single guide were to be recommended to both experienced and novice bird-watchers then I know of few better than this one. It will be a worthy addition to any ornithologist's library and for what is involved, well worth the cost.

Bernard Zonfrillo

Eagles

REBECCA L. GAMBO

Colin Baxter Photography Ltd., Grantown-on-Spey, 1999, 72 pp., softback with numerous colour photographs and three maps. ISBN 1 900455 59 5, £11.00.

This modest addition to the World Life Library is illustrated, as one would expect, with superb plates which combine aesthetics of these majestic birds and their environment with aspects of their form and function, behaviour and habitat related to the text. Written by an enthusiast and expert natural historian from Canada, it deals concisely with the 10 Sea or Fish Eagles, 14+ Snake or Serpent Eagles, 6 Harpy or Buteonine Eagles, and 34+ Booted or Tree Eagles which include our own Golden Eagle (*Aquila chrysaetos*) and the American Bald Eagle (*Haliaeetus leucocephalus*) which last Gambo has studied in detail. Form and function, habits, relations with our human species and prospects for the future are discussed in language easy for non-experts but with elements of research and speculation to interest more knowledged readers. Use of the index is impaired by a few missing page numbers, and on p. 50 the wintering range is faintly illegible, but these minor points do not spoil this delightful book.

Norman R. Grist

Puffins (World Life Library)

KENNY TAYLOR

Colin Baxter, Grantown-on-Spey, Scotland, 1999, 72 pp., softback with many colour photographs, select bibliography, 3 maps. ISBN 1 900455 63 3, £8.

This is a useful book outlining the habits of Atlantic, horned and tufted puffins. There is an interesting discussion on how and why puffins have developed their attractive plumage and bills. The choice of nest sites and food are noted and it was fascinating to learn of the use of endoscopes to study Atlantic puffins' behaviour within their inaccessible burrows in Shetland. The book is beautifully illustrated by high quality photographs which are a pleasure to look at. However, it is a pity that the text is marred by some sloppy use of English and that American spelling has been used although the imprint is British. The author's attempts at writing in a light hearted style were irritating and out of place. At £8 the book is reasonably priced.

Margaret M.H. Lyth

Bat Workers Manual (second edition)

A.J. Mitchell-Jones & A.P. McLeish (editors), illustrated by T.P. McOwat

Joint Nature Conservation Committee, Peterborough, 1999, 138 pp., softback with many black and white illustrations and diagrams. ISBN 1 86107 462X, £20 (£10 for eligible purchasers).

Prior to the first edition coming out just over a decade ago, I was active in the bat scene and the manual was looked forward to with eager anticipation. As it was a publication basically by enthusiastic amateurs there were a number of delays, one of which was attributed to the artist's cat urinating on the prototype sketches. The first edition had 108 pages as opposed to the 138 pages of the current edition. The increased number of pages is due to improving the layout and including additional information on bat detectors and very importantly 'health and safety' for bat workers. This was a subject which I felt concerned about, when examining disused mines where the roofs were supported by rotting timbers. The contents of the manual comprise: Bats and the Law, Health and Safety in Bat work, Surveys, Catching Bats, Examining Bats, Ringing, Handling Bats, Bat Groups, Public Relations, Timber Treatment, and Conserving Bats.

In conclusion, this publication is a must for the bat worker and for those interested in conservation: an excellent buy.

Ian C. McCallum

The Variety of Life

COLIN TUDGE

Oxford University Press, Oxford, 2000, 684 pp., hardback with numerous monochrome drawings. ISBN 0 19 850311 3, £35.00.

According to the legend on the dust-cover, this book is the work of a decade and the culmination of the author's lifetime's interest. This is wholly credible as it is a substantial and serious work of scholarship. In essence, it is an attempt to arrange all living organisms, from the lowliest bacteria to the highest animals, plants and fungi, into a natural classification , i.e. in terms of their phylogeny and true relationships. The results of this are expressed in a series of cladistic trees in which common origins and close relationships are represented as common stems and adjacent branches. This, of course, was an immense task and much depended on distinguishing shared derived characters (synapomorphies), which express true relationships from shared primitive characters (symplesiomorphies) which do not.

Many different criteria are used in classification with much emphasis nowadays on macromolecular studies (DNA, proteins etc.), and although the author does express some of his own views most of his material has been gained by discussions with numerous experts in Britain and the USA. The material is, therefore, as up-to-date and authoritative as possible. In many instances interrelationships seem clear but there are also many uncertainties. These are indicated both in the text and in the diagrams of cladistic trees.

The book is well-written and user-friendly. Many technical terms are used but are explained fully. The author warns against over-pedantic use of nomenclature based on cladistic principles: e.g. in cladistic terms, reptiles would have no individual status but should be described as 'non-avian, non-mammalian amniotes' which is clearly ridiculous. To meet such difficulties he advocates the convenience of using 'grades', groups which lack formal cladistic status, but are easily recognisable.Their names can then be used but can be distinguished from clades by spelling them with an initial lower-case letter, e.g. reptiles, or latinised with an asterisk, Reptilia*.

After introductory chapters on classification and its techniques, the main text reviews all forms of present and extinct living organisms, with special sections devoted to the flowering plants and the descent of Man. A short section on conservation in relation to diversity follows and a bibliography , general index and index of organisms conclude the book. There are no photographs but many line drawings illustrate items mentioned in the text.

A few minor errors were noted. The first segment of the thorax does not bear wings in flies (p. 183); woodlice are truly terrestrial (p. 262 cf. p.285); the insect figured on p. 296 is not a proturan; damselflies do not have rectal gills (p.298); river blindness is not carried by mosquitoes (p. 306); fleas are Siphonaptera (p. 305-6); the acariform mite figured on p. 321 is a tick; the illustration of a 7-toed Ichthyostega on p. 398 has five toes; for demopterans on p. 447 read dermopterans; on p. 503 for censensus read consensus.

The author is to be congratulated on the production of this major work.

Ronald M. Dobson

ERRATA AND CORRECTIONS

Correction

Loch Lomondside: Early Maps and Map Makers

In the above paper (Mitchell, 1999) I followed Stirling map collector and publisher J.E. Shearer (1905) and D.G. Moir (1983) in giving the date of belated publication of William Edgar's *Map of Stirlingshire* as 1777. It would appear that Edgar's map was in fact first published much earlier, if we take into account the following statement made by Dr. P. Graham in his *Agriculture of Stirlingshire* (1812)...."In 1745 a survey was made of this county [present author's note: a surviving manuscript copy in the British Library shows that the field work was actually complete by 1743], and a map published by William Edgar; some copies of which are still to be met with". Regrettably the 1745 map is no longer 'to be met with' in any public collection, but as Dr. Graham goes on to point out, it was republished with some additions in the first edition of the Reverend W. Nimmo's *General History of Stirlingshire*, 1777. The most common version of Edgar's *Map of Stirlingshire*, however, is the slightly reduced facsimile published by J.E. Shearer in 1892.

Mitchell, J. (1999). Loch Lomond Depicted and Described: 2. Early Maps and Map Makers. *The Glasgow Naturalist* **23** (4), 2-8.

Moir, D.G. (1983). *The Early Maps of Scotland* Vol. 2 (3^{rd} ed.). Royal Scottish Geographical Society, Edinburgh.

Shearer, J.E. (1905). Maps of Scotland, Ancient and Modern; Pt. 2 – District Maps of Scotland. *Transactions of the Stirling Natural History and Archaeological Society* 27, 65-78.

John Mitchell

Errata

The barklice (Insecta: Psocoptera) of the Lothians (Scotland)

In the above paper (*Glasgow Naturalist* Vol. 23 Pt. 4 pp. 50-54) the name of the first species in column 2 of p.51 should read *Stenopsocus immaculatus*, not *immaulatus*.

Camilla Dickson, botanist

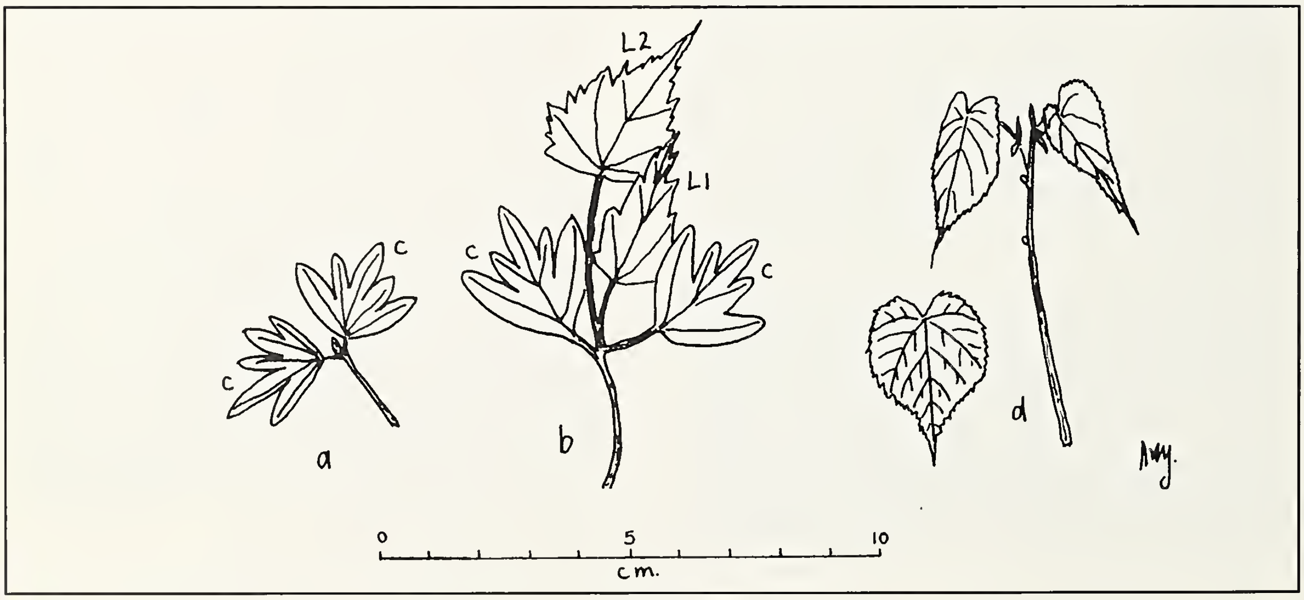
In the above obituary (*Glasgow Naturalist* Vol. 23 Pt. 4 pp. 73-4, the final sentence on p. 73 should read 'By meticulous research she identified most of the seeds, pollen and plant remains, and produced the first detailed profile of the diet of Roman troops in Scotland.'

Natural regeneration of limes (*Tilia* spp.) in Scotland

The following material was inadvertently omitted from the above paper (*Glasgow Naturalist* Vol. 23, Pt. 4 pp. 19-25):

On p.20, after see Plate 2, insert 'and Fig. 3'. Figure 3 is shown below.

Fig. 3 Lime tree seedlings A: late May 1997, palmate cotyledons (c): B: mid July 1997, cotyledons (c): first true leaves (L1, L2): (c): mid April 1998, second year seedling, germinated 1997.



On p.21, for Table 5, read Table 6. Table 6 is given below.
Table 6
Monthly Mean Temperature Maxima (degrees C.)
(Abbotsinch 1998 to 1966 & Renfrew 1965 to 1959)

	98	97	96	95	94	93	92	91	90	89
June		17.9	18.0	19.5	16.1	17.3	19.5	16.1	17.4	17.9
July	17.9	20.3	19.2	20.8	19.8	16.9	18.7	20.5	19.7	22.2
Aug.	18.5	21.6	20.2	22.8	18.1	17.5	17.3	19.3	18.9	18.1
Sept.		16.6	17.7	16.7	15.4	16.6	15.0	17.5	15.4	16.0

	88	87	86	85	84	83	82	81	80	79
June	19.7	15.9	17.9	16.3	17.9	16.6				
July	17.0	19.1	17.7	17.6	21.5	21.8	21.1	17.8	17.9	17.6
Aug.	17.7	18.4	16.8	16.4	21.5	21.4	18.2	19.2	17.5	17.4
Sept.	15.4	15.7	15.1	15.0	15.4	15.2				

	78	77	76	75	74	73	72	71	70	69
July	18.2	20.7	21.6	19.6	17.2	19.2	19.2	19.7	16.6	18.9
Aug.	17.5	18.8	21.9	21.6	18.1	18.5	17.7	18.0	19.4	19.9

	68	67	66	65	64	63	62	61	60	59
July	18.0	17.6	18.3	16.6	17.8	17.7	17.6	17.5	18.5	19.5
Aug.	19.0	18.3	17.5	17.5	17.7	17.0	16.7	17.7	18.9	20.4

Long term (30 year) average of monthly means:

July 1998 = 18.8 degrees C.

August 1998 = 18.5 degrees C.

1995 was the sunniest summer on record

Turnhouse (1996 to 1982)

	96	95	94	93	92	91	90	89	88	87
June	18.9	18.4	17.7	16.5	18.4	15.7	17.4	18.1	18.0	16.8
July	19.9	20.4	19.7	17.9	18.6	19.2	19.0	21.7	17.8	18.7
Aug.	20.5	22.1	18.9	17.9	17.8	20.0	20.1	19.0	18.5	18.5
Sept.	17.7	16.5	15.5	15.5	14.6	17.1	16.0	16.3	16.1	16.0

	86	85	84	83	82
June	16.6	15.7	17.4	16.4	16.4
July	18.5	18.0	21.5	20.6	19.7
Aug.	15.9	17.5	20.2	20.9	18.6
Sept.	15.1	15.6	15.7	15.7	16.9

PROCEEDINGS 1999

The Chairman, place*, number present, lecturer's name and title of lecture are given for most meetings.

*BOB Boyd Orr Building

GKB Graham Kerr Building

HL Hillhead Library

14th January
Norman Tait, BOB, 39,30th Paisley International Colour Slide Exhibition, Natural History Section, Compiled by members of Paisley Colour Photographic Club and presented by Winifred Brown and projected by Jim Campbell.

9th February
Norman Tait, BOB, 54, Presidential Address: "Images of Nature", given by retiring President.

23rd February
Norman Tait, BOB, well attended, 69th AGM. Reports were presented on activities during 1998, and elections held, resulting in appointments as shown opposite. Membership stands at 229 made up of 188 ordinary, 19 family, 9 junior, 4 school, and 9 honorary members. There were 3 Council Meetings and the executive met informally as required.

AGM was followed by an illustrated talk - "Wildlife in the City", by Jim Coyle of Glasgow District Council.

9th March
Bob Gray, BOB, 38, "Birds of Siberia", speaker, Brian Little.

13th April
Bob Gray, BOB, 32, "Basking Sharks in Scotland", speaker David Wilson, formerly Western Officer with SWT & now working for the SSPCA.

11th May
Bob Gray, BOB, 35, "Promoting Biodiversity", speaker Anne-Marie Smout.

1st October
Bob Gray, GKB, 41, welcomed members to the Exhibition Meeting with Wine and Cheese.

12th October
Bob Gray, GKB, 40, Blodwen Lloyd Binns Lecture, Dr Sandy Gray (University of Strathclyde) - "Medicine Man in the Colombian Amazon".

26th October
Bob Gray, GKB, 38, Members Slide Night; 6 Members presented varied slide shows.

9th November
Helen Abdy (President of Friends of the Botanics Gardens), HL, 65 (both societies), jointly with Friends of the Botanics Gardens - Martin Gardner, "From Dahlias to Monkey Puzzles - Plant Hunting in Central and South America".

23rd November
Bob Gray, GKB, 58, "Alaska", speaker, Prof Jim Dickson.

13th December
Bob Gray, Glasgow University College Club, 33 attended an excellent Christmas Dinner and after the meal we heard Geoff Hancock talk about his expedition to Costa Rica.

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THE GLASGOW NATURALIST
Advice to Contributors

1. The Glasgow Naturalist publishes articles, short notes and book reviews. Book reviews are commissioned by the Librarian and all books reviewed are kept in the Society's Library. Articles and short notes should be sent to The Editor, Glasgow Naturalist, c/o Natural History Department, Museum and Art Gallery, Kelvingrove, Glasgow G3 8AG. Short notes are edited by Mr A. McG. Stirling. Articles are refereed by the Editorial Board. Final acceptance of articles and short notes is the responsibility of the Editor. The journal is usually issued in May each year. The subject matter of articles and short notes should concern the Natural History of Scotland in all its aspects, including historical treatments of natural historians.

2. Short notes should not normally exceed one page of A4 single-spaced. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references.

Short notes may cover, for example, new stations for a species, rediscoveries of old records, additions to records in the Atlas of the British Flora, unusual dates of flowering, unusual colour forms, ringed birds recovered, weather notes, occurrences known to be rare, interesting localities not usually visited by naturalists, and preliminary observations designed to stimulate more general interest.

3. Articles should be more substantial than short notes, and have no upper limit of length. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. The text should normally be divided into sections with sub-headings such as Introduction, Methods, Acknowledgements, etc.

4. References should be given in full (please do not abbreviate journal titles) according to the following style:

Pennie, I.D. (1951). Distribution of Capercaillie in Scotland. *Scottish Naturalist* 63, 4-17.

Wheeler, A. (1975). *Fishes of the World.* Ferndale Editions, London.

Grist N.R. & Bell, E.J (1996). Enteroviruses. Pp. 381-90 in Weatherall, D.J. (editor) *Oxford Textbook of Medicine.* Oxford University Press, Oxford.

5. The nomenclature of vascular plants should be as in Stace, C.A. (1997). *The new Flora of the British Isles,* (Second Edition) Cambridge University Press, Cambridge. Normal rules of zoological nomenclature apply.

Please use lower case initial letters for all common names e.g. wood avens; blackbird, unless the common name includes a normally capitalised proper name e.g. Kemp's ridley.

Where giving distribution information by vice-county, use the following style: VC 30.

6. Submitted manuscripts (two copies) should be typed double-spaced on A4 paper. Once a manuscript has been accepted, typesetting is greatly assisted if the manuscript can be supplied on a microcomputer diskette. Authors are therefore strongly encouraged to produce manuscripts using a wordprocessor (preferably on a PC-compatible microcomputer). However, to assist amateur naturalists, the Editor can make arrangements to have hand-written manuscripts typed.

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8. Line drawings and photographs are numbered in sequence in arabic numerals e.g. Fig. 1. If an illustration has more than one part, each should be identified as 9a), (b) etc. The orientation of the figure and name of the first author should be indicated on the back. They should be supplied camera-ready for uniform reduction of one-half on A4 size paper. Line drawings should be drawn and fully labelled in Indian ink, dry-print lettering or laser printed. A metric scale must be inserted in micrographs etc. Legends for illustrations should be typed on a separate sheet. The Editor is able to accept a small number of high quality colour photographs for each issue.

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10. Ten offprints and one complimentary copy of the Journal are provided free of charge. Further copies may be purchased, provided that they are ordered at the time the proofs are returned.

11. All submissions are liable to assessment by the Editor for ethical considerations, and publication may be refused on the recommendation of the Publications Committee.

Acknowledgements
The Editor wishes to thank Irene McLaren for typing. Norman Tait for preparing the photographs, and Universities Design and Print for their expert printing work.

Front Cover
Insert: Holy grass (*Hierochloe odorata*) flowering, April 2000.

Background: A view looking north-west showing the holy grass emerging from tidal debris at Site 2. The Black Cart Water and Colin's Isle are seen in the background, April 1999.

Photos: T. Norman Tait.

Back Cover
Fig. 1: Gulliver *et al.* Observations on Irish lady's tresses. Legend P10.

Photos: Richard Gulliver.

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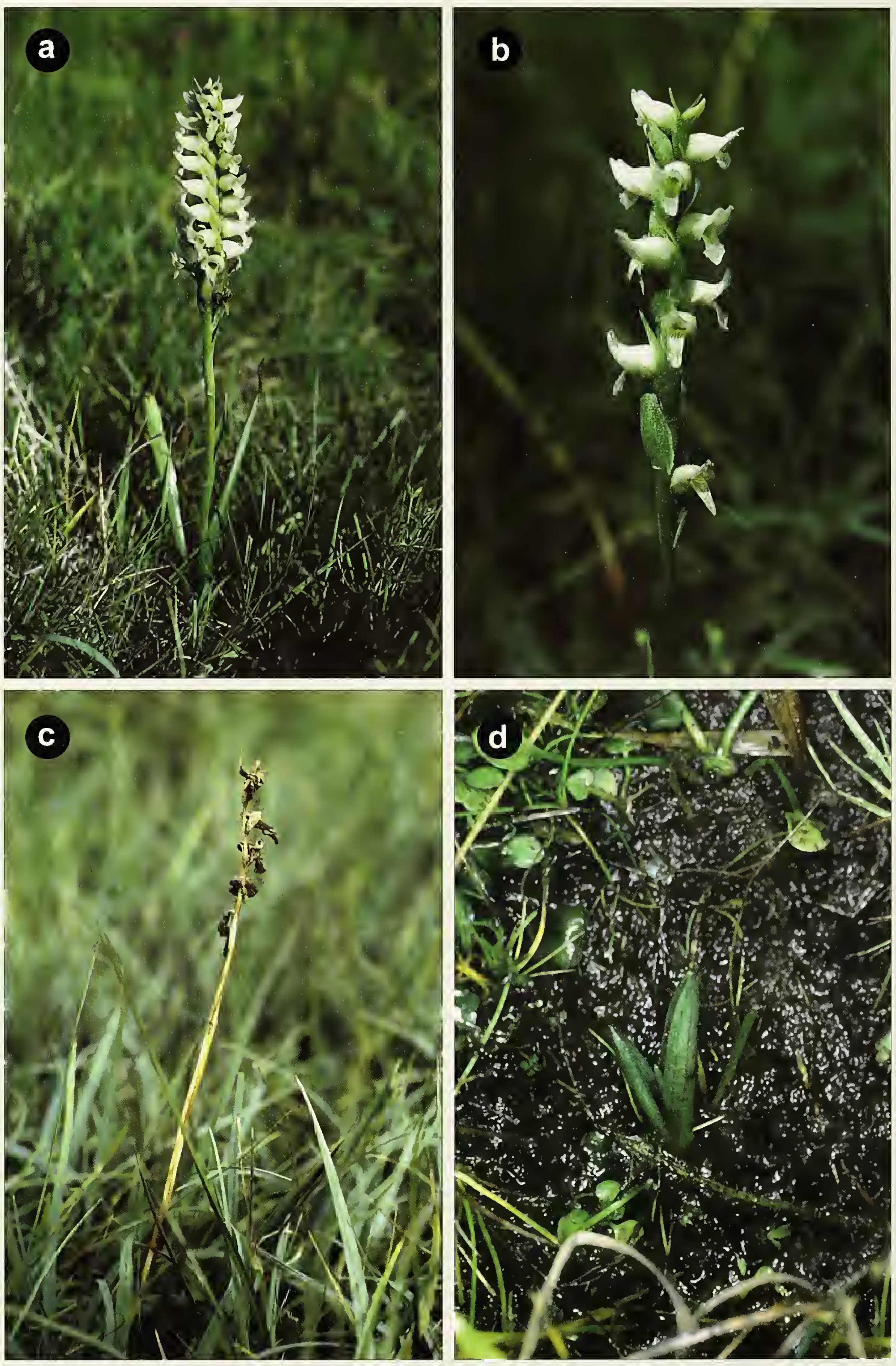

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The Glasgow Naturalist

150th ANNIVERSARY
GLASGOW NATURAL HISTORY SOCIETY
1851 2001

Volume 23

Part 6 2001

Journal of
THE GLASGOW NATURAL HISTORY SOCIETY

GLASGOW NATURAL HISTORY SOCIETY

(formerly The Andersonian Naturalists of Glasgow)

The object of the Society is the encouragement of the study of natural history in all its branches, by meeting for reading and discussing papers and exhibiting specimens and by excursions for field work. The Glasgow Natural History Society meets at least once a month except during July and August, in the University of Glasgow, the Glasgow Art Gallery and Museum, or Hillhead Library.

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The Glasgow Naturalist

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Contributions are invited, especially when they bear on the natural history of Scotland. A note of information for contributors is printed on the inside back cover.

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Proceedings and Transactions of the Natural History Society of Glasgow Vol. II pt. 2; Vol. VI pt. 1; Vol. VII, pt. 3; Vol. VIII, pts. 1 & 2.

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The Flora of Ailsa Craig. B. ZONFRILLO, 1994. Price £2.50 plus p.& p.50p.

The Natural History of the Muck Islands, N. Ebudes:

1. Introduction and Vegetation with a List of Vascular Plants. R.H. DOBSON & R.M. DOBSON, 1985. Price £1.00 plus p. & p. 50p.
3. Seabirds and Wildfowl. R.H. DOBSON & R.M. DOBSON, 1986. Price £1.00 plus p. & p. 50p.
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The Glasgow Naturalist
Volume 23, Part 6, 2001

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EDITORIAL Evolution and religion: an unnecessary conflict?

On Monday 26th February, 2001, the *Herald* devoted a generous three-quarters of a page to a natural history story by their environment correspondent, James Freeman. The story described the work of Colin Adams and Gavin Alexander (University of Glasgow Field Station, Loch Lomond) in identifying over 30 unique populations of Arctic Charr in Scottish freshwater lochs. Colin Adams was quoted as being concerned over the conservation of these genetically unique populations, each of which has diverged from common stock which invaded after the last Ice Age recorded 7-8000 years ago. He also pointed to the inherent interest of these populations as examples of evolution in action: in some Lochs, up to three separate forms (with different ecology, morphology and life histories) now exist, and the small degree of gene flow between the different forms suggests that speciation is well on the way. A fascinating example, and, almost 150 years after the publication of *The Origin of Species*, pretty uncontroversial, you might have thought.

The next day, the *Herald's* columnist, John MacLeod, launched an attack on Dr Adams for his interpretation of the findings in Darwinian terms: For MacLeod, this was "smart men pouring ideological propaganda into the minds of the gullible public". He proceeded: "Evolution is not a fact, nor even a scientific theory, but a hypothesis for which no convincing proof exists". Claiming to be a "wordsmith" who takes words seriously, he then presented a travesty of the theory of evolution, concluding, bizarrely, that Dr Adams's work "does not prove evolution: it demonstrates natural selection. No-one disputes natural selection".

The following day's letters page carried eight letters attacking MacLeod, including one from Richard Dawkins who uses his position as Charles Simonyi Professor at Oxford to hack down the rank weed of creationism wherever it grows. In the week or so following MacLeod's article, the *Herald* printed 36 letters on the topic (several of them from overseas), plus a follow-up article by MacLeod (attacking Dawkins). A rough break-down of the letters gives 11 for evolution and 7 for MacLeod; the remainder were comments on the controversy itself (was it merely a ploy by the editor to refresh a tired letters page?), or discussions on the relationship between science and religion, and on the nature of scientific knowledge.

There were no letters from current members of GNHS, other than a reply to MacLeod from Colin Adams himself. I wonder how many members of the Society read the correspondence, and how many sent letters in.

One letter from the state of Kansas in the U.S.A. contrasted the high prevalence of creationist influence in the U.S.A. with the situation in the UK where views like MacLeod's "represent only a tiny portion of the population on the extreme fringe of scientific and political thinking". Unfortunately, this is not quite the case. Based on a 12 year survey of Glasgow University students, we have shown (Downie & Barron, 2000) that 4-11% of first year biology students do not accept that evolution has occurred: for medical students, in a single year, the figure was 10%. I do not regard this as a "tiny portion", especially when it is a survey of young people who have received a biological education. Rejection of evolution correlated strongly with religious belief, mainly various sorts of Christianity or Islam. However, over half of those accepting evolution also claimed to hold a religious faith.

When asked for their reasons for rejecting evolution, only a third stated that the evidence for evolution is full of conflicts and contradictions, whereas 70% gave as their reason their acceptance of the literal truth of a religious creation account that excludes evolution.

Similarly, when these students were asked what sort of evidence they would require to convince them that evolution has occurred, a high proportion of respondents stated that no such evidence could be obtained. I find it worrying that a group of young people embarking on higher education in science, where an open mind to new ideas is of the essence, should have such an attitude.

Our findings also help to demonstrate the bankruptcy of so-called "creation science". In the U.S.A., where the public school system does not permit the teaching of particular religious beliefs, creationists have attempted to infiltrate the schools by claiming equal time for the teaching of their alternative to evolution, under the guise of "creation science". It is clear, however, that our evolution-rejecters did not base their views on anything that resembles science.

Evolutionary biology is a vibrant branch of modern science, providing a unifying theme for the biological and earth sciences. Scientific papers pour annually out of research institutes around the world: as in any active science, controversy abounds. But the controversy is not on whether evolution has occurred - the evidence for that is clear. What is interesting is the details of how it has occurred. Darwin and Wallace remain key founders of these ideas, but the subject has moved a long way since their times, as would be expected from any healthy science after 150 years of endeavour. It is somewhat bewildering, therefore, that so many people prefer to bury their heads in the sand, claiming that nothing is known, nothing can be proved. Though the numbers of evolution-rejecters are relatively small in the U.K., this is not the case everywhere, as an excellent series in *New Scientist* showed last year (MacKenzie, 2000).

In part, the problem is one of ignorance. I can illustrate from personal experience of debating with a group of creationists. A keystone of their beliefs is that God created all the "kinds" of organisms and that no new kinds have appeared since. I pointed out that we have direct evidence of many new species, usually formed by hybridisation events, with the new generation unable to interbreed with either parental species. They were shocked to hear this, and wanted to know what sorts of organisms were involved. I replied that this was commonest in plants, such as various species of grasses. This relieved them: grasses are all one kind, according to them!

However, ignorance is only part of the story. We are all mostly ignorant of the latest advances in most sciences. This is an inevitable effect of the speed, diversity and difficulty of the advances that are occurring. It is difficult to communicate most aspects of modern science to the general public, and many scientists don't even try. But the public does not generally attempt to deny the bases of these sciences or the truth of the advances scientists make. It is only in evolutionary biology that such a fundamental challenge exists.

And yet, as several of the letters in the *Herald* correspondence pointed out (including the one by Dawkins), there is no necessary incompatibility between religious belief and an acceptance that living organisms have originated through an evolutionary process. One of the most interesting of the letters cited the example of a 19th century Scots philosopher and theologian, James McCosh, and sent me to the library to research the contribution of this remarkable figure.

McCosh came from the Ayrshire countryside to study philosophy and mathematics at the University of Glasgow in 1824, at the age of 13 (it was not uncommon then for bright boys to start university young: William Thomson, later Lord Kelvin, matriculated at 10 years). He became a minister but retained academic interests and went on to become a professor of philosophy at Queens College Belfast, then President of Princeton College in the United States, laying the foundations for its eventual University status.

McCosh belonged to the evangelical/Puritan wing of the Church of Scotland and joined Thomas Chalmers and the many others who left to form a disestablished Free Church in 1843.

One of McCosh's interests was the diversity of the natural world. Just before the appearance of *Origin of Species* he co-wrote a book (McCosh and Dickie, 1856) on the variety of natural forms. This appeared at a time of great scientific and philosophical ferment, some of it originating in Scotland where the geologist Hugh Miller and the writer Robert Chambers were key figures. McCosh accepted the geological evidence of the Earth's great antiquity and was not averse to species changing, as long as this was part of God's plan. As a modern account of his career shows (Hoeveler, 1981), McCosh later came to accept some of Darwin's ideas on evolution and natural selection, while retaining a role for a creator who controlled the process and had a goal in mind. Unlike the literalist creationists of to-day, McCosh allied his deep-seated faith to a flexible and enquiring mind and was determined to set his interpretation of the world in the context of accumulating scientific evidence.

A recent approach to the science-religion debate is Stephen Jay Gould's lively new book *Rocks of Ages* (2001) where he outlines his idea of "non-overlapping magisteria" or NOMA for short. For Gould, the magisterium of science "covers the empirical realm: what is the universe made of (fact) and why does it work this way (theory). The magisterium of religion extends over questions of ultimate meaning and moral value. These magisteria do not overlap, nor do they encompass all enquiry (consider, for example, the magisteria of art and the meaning of beauty)". Gould notes that science is a latecomer in human history: theology once occupied the realm of factual inquiry, and has not retreated without a struggle - but it may be stronger as a result of this retreat, because it can concentrate on what it does best.

It is important to note that Gould is not suggesting that science as an activity carried out by people is separate from human values. There are many ways in which scientists need to think about the ethical dimension of their activities, for example in experimenting on animals.

There is an interesting thread of connections between the first three articles in this issue of *Glasgow Naturalist*. John Mitchell's essay on the geologists of Loch Lomond (Ps. 4-8) recounts the importance of a visit to the area by the great Swiss palaeontologist/geologist Louis Agassiz, who recognised the evidence of the glaciations there. Agassiz moved to the U.S.A. to a chair at Harvard in the mid 1840s and became one of Darwin's fiercest critics amongst the natural historians of the time. From Agassiz's zoological collections, the great Harvard Museum of Comparative Zoology grew from the 1850's. Agassiz's son Alexander, a noted marine biologist, particularly interested in coral reefs, curated the Museum for most of his working life, and Stephen Jay Gould's chair at Harvard is named after Alexander (Agassiz, 1913).

George Farrow's essay on James Croll (Ps 9-18) notes that he also had an interest in the geology of Loch Lomond, but in addition that his calculations of the age of the Earth, based on known sedimentation rates, were a considerable solace to Darwin in his disputes with opponents of evolution. Croll's estimates were much nearer to what we now accept than those of his mentor, Lord Kelvin, who famously reckoned that on the known laws of physics, the Earth could be no older than 100 million years "unless sources now unknown to us are prepared in the great storehouse of creation". This important proviso of the careful scientist soon became reality with the discovery of the energy locked up in atoms (Romer, 1958). Croll is also interesting as a scientist distressed by what seemed to be a growing conflict between science and religion: I think that he would have approved of NOMA.

I doubt that Gould's approach will satisfy John MacLeod, but it seems a sensible interpretation of the way in which many religious people have accommodated their beliefs to advances in scientific understanding. Gould cites as part of his case Pope John Paul's statement that new knowledge has made the theory of evolution "more than a hypothesis".

It would be interesting to hear the views of Glasgow's natural historians on this debate. As I've noted elsewhere (Downie, 2001), neither the proceedings nor the published papers of the Society indicate any considerable engagement with the major modern advances in the biological sciences. Is our Society taking too narrow a view of what natural history is?

ACKNOWLEDGEMENT

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Roger Downie[1]

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[1] This is my final normal edition as editor under the current arrangements, thought I will also be involved in the production of the 150th Anniversary Conference proceedings as a Supplement to the *Glasgow Naturalist.* I have enjoyed the job, though it has been a demanding and time-consuming task. I hope that readers have appreciated the innovation of the editorial essays, in which I have attempted to take a broad view of natural history and to raise issues for debate. Feedback welcomed!

GLASGOW NATURALIST Vol. 23 Part 6 pp 4-8 (2001)

LOCH LOMONDSIDE DEPICTED AND DESCRIBED
4. EARLY GEOLOGISTS AND GEOMORPHOLOGISTS

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"If only the geologists would let me alone, I could do very well but for those dreadful hammers. I hear the clink of them at the end of every cadence of the Bible verses". *John Ruskin (1851)*

INTRODUCTION

The present paper covers the late 18th to the late 19th centuries, drawing attention to just a few of the men of scientific thought and practical field investigation who laid the foundations to our understanding of the geological fabric and evolved land forms on Loch Lomondside. It was a time not only of widely differing opinions on the two subjects between the geologists and geomorphologists themselves, but of a seemingly irreconcilable conflict between some of the new discoveries and the teachings of the Christian Church. This account in fact ends with the last throes of a long drawn out struggle between the Diluvialists - those with a conviction that the land surface had been shaped by the biblical and other cataclysmic floods - and the Glacialists who interpreted much the same physical evidence as belonging to an age of ice.

In the beginning of the chosen period, the study of geology and land forms was the preserve of the university lecturer, the clergy, medical men and the occasional gentleman of leisure. The advent of the first government-employed professional geologists in the years which followed was paralleled by the emergence of geological societies, whose memberships were largely made up of amateur 'brethren of the hammer' drawn from almost all walks of life.

SOME EARLY PIONEERS

The preparation of the first *Statistical Account of Scotland* towards the end of the 18th century gave all Church of Scotland ministers resident on Loch Lomondside the opportunity of describing the physical advantages and disadvantages of their respective parishes. In almost every instance the contributors' geological comments were restricted to the local building stone and any calcium-rich strata suitable for conversion into agricultural fertilisers. However, one, the Reverend David Ure (1749-1798) acting as a stand-in writer for the parish of Killearn account published in 1795, went further than his fellow clerics by including notable geological features of the immediate area, such as the water-worn red sandstone ravine of Finnich Glen and the basaltic pillars that outcrop along the northern scarp of the Campsie Fells. Ure was also the compiler of a *General View of the Agriculture in the County of Dumbarton* (1794). The work contains a brief geological description of Dunbartonshire plus several pages devoted to the county's rocks of economic worth.

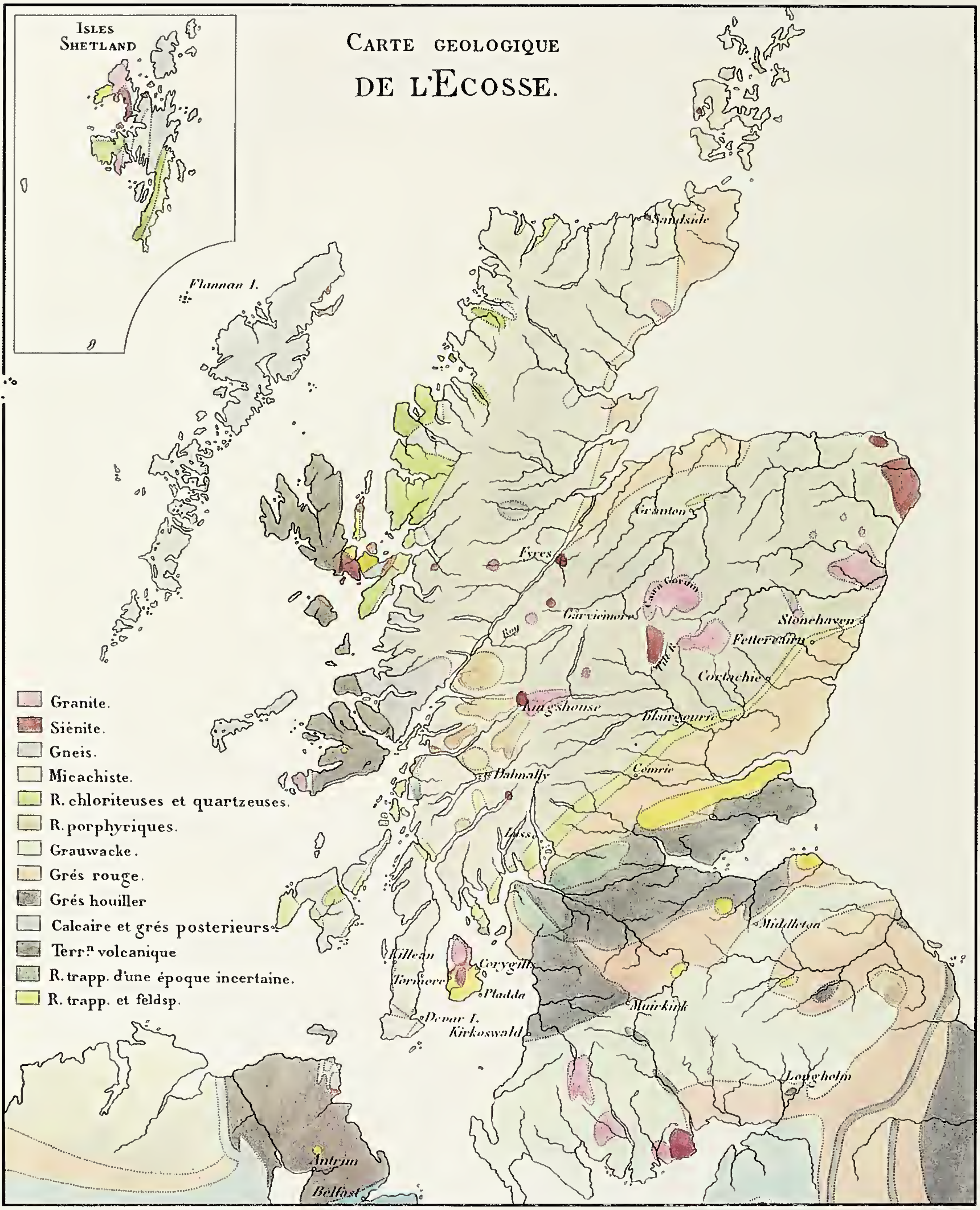
Dr Patrick Graham (1756-1835) of Aberfoyle was another divine with a particular interest in the subject of minerals and soils; his description of east Loch Lomondside is to be found in the *Agricultural Report for Stirlingshire* published in 1812. Graham's revised *Sketches of Perthshire*, which appeared in the same year, is well spiced with original observations on the local geology, although he was unable to come to terms with the concept of a continuous cycle of erosion and re-deposition of rock material since the beginning of time as propounded by the emerging Uniformitarianists.

Among the academics, Dr John Scouler (1804-1871) deserves mention. In 1829 he was appointed Professor of Natural History at Anderson's College in Glasgow, a position he was to hold for the next five years. To judge from an extract taken from his student lecture notes on the Strathblane area, which by chance found its way into the *New Statistical Account* for the parish published in 1841, Scouler may well have been the first to recognise that the floor of the present Blane Valley represents the bed of a long disappeared freshwater lake.

THE FIRST GEOLOGICAL MAPS AND AN EARLY GEOLOGICAL GUIDE

Geological maps covering any part of Loch Lomondside were unavailable before the 19th century. The earliest were all hand-coloured, for colour printing of geological maps was not introduced to Scotland until 1845, and it was to be another fifty years before it became standard practice.

A map prepared by William Smith (1769-1839) of Oxfordshire led the way. A canal and drainage engineer by profession, Smith's work gave him the opportunity of travelling throughout much of Britain. Although details are lacking, his business trips would seem to have included



Digital Image Restoration by T. Norman Tait

Fig. 1. Ami Boué's *Geological Map of Scotland* (1820)

southern Scotland as far north as the Highland line. William Smith's five miles to one inch *Delineation of the Strata of England and Wales with part of Scotland* (1815) takes in all of lowland Loch Lomondside. Issued with an explanatory memoir, the map is justifiably considered the beginning of modern geological cartography.

The first published geological map of the whole of Scotland was issued in Paris by Dr Ami Boué (1794-1881) as an illustration to his *Essai Géologique Sur L'Écosse* (1820). This small scale map (Fig. 1) combined the results of Boué's own investigations together with the Scottish geological literature and regional maps available to him. As a medical student Boué had studied in Edinburgh from 1814 to 1818, during which time he also attended the geological lectures of Professor Jameson (1774-1854) who held the Chair of Natural History at the University. Boué's only known geological excursion to Loch Lomondside took place in the spring of 1815, and included ascending Ben Lomond and visiting the well-known localities for zeolites in the Kilpatrick Hills. Despite having been subject to Jameson's tutoring according to the Wernarian doctrine - which purported that almost all rocks are formed from successive precipitates laid down when the earth was enveloped in a vast universal ocean - it is to Boué's credit that he recognised the terrestrial origin of the Clyde Plateau lavas. An inveterate traveller, Dr Boué went on to prepare several continental geological maps, including one of Transylvania - immortalised by the author Bram Stoker as the gothic setting for Count Dracula's castle.

Another former Edinburgh medical student active in the field was Dr John MacCulloch (1773-1835). Following a brief career as an army surgeon, MacCulloch travelled extensively throughout Scotland between the years 1811 and 1821, from 1814 onwards as geologist to the Trigometrical Survey. According to a statement in his descriptive four volume work *The Highlands and Western Islands of Scotland* (1824), MacCulloch made frequent visits to Loch Lomondside, but no specific dates are given. In 1826 MacCulloch was commissioned by the government to prepare a geological map of Scotland, the fieldwork for which he completed single-handedly by 1832. Unfortunately he was tragically killed in a carriage accident while on his honeymoon at the age of 62, and his four miles to one inch geological map was published posthumously in 1836.

Students of geology residing in the Glasgow area have been well provided for with printed excursion guides for over a century, the very first compiled by Dugald Bell. Bell (1827-1898) spent his formative years on Loch Lomondside, where his father held the position of head gardener at Cameron House. In 1860 he joined the newly formed Geological Society of Glasgow, becoming Secretary and Vice-president in turn. A contributor of the Society's excursion reports to Glasgow's *Evening Times* and *Weekly Herald*, his newspaper articles were re-issued in a collected form in 1881 (with a second edition in 1885) under the title *Among The Rocks Round Glasgow*. Southern Loch Lomondside is included in this work, with descriptions of Dumbarton Rock, Ballagan Glen and the Whangie, together with Bell's tentative observations on the former presence of glaciers.

THE GEOLOGICAL SURVEY OF SCOTLAND

The Geological Survey of Great Britain was founded in 1835, but field work was held back in Scotland until the availability of the first large-scale Ordnance Survey maps, with the Loch Lomondside OS maps not published until the 1860s. Progress was frustratingly slow in the mountainous regions, for the Geological Survey officers' field season was more or less confined to a few mid-summer months. In spring most of the higher hills were still well covered in snow, while in late summer and autumn, access was often denied by the sporting estates. Even if weather conditions were perfect the officers could rarely work on a Sunday, for in the Highlands it was not only sample rocks they would be breaking, but the custom of strict Sabbath observance. Glasgow-born Andrew Crombie Ramsay (1814-1891), who had joined the Geological Survey in England as early as 1841, was the first officer to undertake mapping work in Scotland, but more on him later as a glacial evangelist.

Recruited to the Geological Survey of Scotland in 1867, Robert Logan Jack (1845-1921) from Ayrshire made a significant contribution to the interpretation of Loch Lomondside's glacial and interglacial history using evidence he obtained from exposures in a newly excavated railway cutting near Catter Mill and elsewhere in the surrounding district (Jack, 1876). Finding worn and fragmented shells of cold water marine molluscs in the overlying boulder clay, Jack deduced that after the retreat of the last major ice sheet which had covered two-thirds of Britain, the still depressed Lomond Valley had become an arm of the sea. This was followed by a more localised resurgence of glacial ice (much later to be named the Loch Lomond Re-advance), which scraped up, carried and deposited the estuarine shell beds a short distance south.

Henry Moubray Cadell (1860-1934) from Linlithgow served briefly with the Geological Survey of Scotland from 1883. He is best known in a Loch Lomondside context for his explanation of how the region's drainage system had been substantially altered by glacial sculpturing. Cadell (1886) postulated that before the Loch Lomond trench was gouged out, rivers which still flow eastwards through the western hills and mountains originally had their continuations on the far side of the present valley, but these were now water courses in their own right which had reversed in direction to discharge into the loch.

Another member of the team, John Roche Dakyns (1836-1910), was transferred from the north of England to Scotland in 1884 to assist in catching-up on the work still required on the hitherto neglected metamorphic rocks. This included the Loch Lomond area north of the Highland line. As a keen hill-walker, Dakyns enjoyed the solitude of the Scottish mountains, especially as he was not required to wear what he described as his 'respectable' clothes. Dakyns made a particularly valuable contribution in surveying some of the roughest and most distant terrain, but found the complexities of the then unrecognised over-folding of the Dalradian sequence on Loch Lomondside particularly perplexing. So much so, that he was once heard to remark that Hell was probably paved with Highland schists!

THE GLACIAL CONTROVERSY

Throughout the first few decades of the 19th century, determined attempts were made by geologists to correlate the phenomenon of displaced surface material - known as diluvium - with the scriptural and other great floods. A Swiss naturalist by the name of Louis Agassiz (1807-1873) put forward an alternative explanation: that in the northern hemisphere at least, this rock-based material had been transported by great ice sheets and valley glaciers moving across the land. Despite the reservations held by the geological establishment at the time, Agassiz was invited to speak on the subject at a meeting of the British Association for the Advancement of Science to be held in Glasgow towards the end of September 1840. His address to the British Association on the 22nd of that month was delivered in Swiss-French, which few of the gathered assembly would have fully understood and almost certainly explains why such an important paper received so little press coverage. Agassiz's presentation was followed by replies from several leading geologists in the audience, who almost unanimously expressed their dissent over the glacial theory.

After the British Association meeting closed, Agassiz, accompanied by William Buckland (Professor of Geology at Oxford University), set off north from Glasgow to seek confirmation of the former existence of glaciers in the Scottish Highlands. Agassiz left no detailed account of his itinerary, but from a paper he later read to the Geological Society of London on 4th November (Agassiz, 1841), it is clear that one of the places he found the telltale signs of polished and striated rock surfaces *in situ* was in the Lomond Valley. This, he informed the society members, convinced him that a thick mass of glacial ice had once moved through the area from north to south. Such a statement was in direct conflict with the then widely held view that all the displaced rock material had resulted from a massive surge of water which had swept across the country from west to east.

That Britain had once gone through a period of intense cold eventually became irrefutable, but it was claimed by the Diluvialists that the biblical and other major floods did not have to be rejected in favour of land ice if the movement of rock material could be attributed to icebergs. The iceberg hypothesis attracted considerable attention as it did not challenge the authority of the *Book of Genesis*, but the consequence of its widespread support was to divert the main thrust of glaciology down a blind alley for some years. Even after general acceptance that moving land ice had been responsible for the deposition of erratic boulders, morainic mounds and a widespread covering of drift, there was still left considerable doubt as to whether or not a valley glacier could excavate its own trench in solid rock up to a depth of hundreds of metres. As a sceptical John Ruskin put it ... "ice can no more erode rock basins than custard can deepen the pie dish". It was during visits to Switzerland that the Scot Andrew Ramsay of the Geological Survey became a convert to the ability of glaciers to grind down bedrock, having realised that the abrasive agent was the rocky debris dragged along beneath the moving ice. This, he believed, provided the solution to how the deeply carved basins of many mountain lakes were formed; and in a paper on his findings read to the Geological Society of London in 1862, Ramsay put forward Loch Lomond as a prime example. The paper initially attracted criticism from many quarters, and had Ramsay not held the Presidency of the Society at the time, it is likely Council would have voted against publication except in bare extract.

One of Ramsay's most vociferous and persistent opponents was George Douglas Campbell (1823-1900), the 8th Duke of Argyll and a man of strong religious conviction. At the 1873 Annual General Meeting of the Geological Society of London, the Duke - now himself with the advantage of the President's chair - contested Ramsay's conclusions and argued that the deep northern trench of Loch Lomond must have already been in existence long before any glaciers passed that way. According to one of Argyll's biographers, as evidence continued to accumulate in favour of moving land ice, the vigour of His Grace's protest against its growing acceptance seemed to augment in proportion. What was in effect a rally for scriptural geology took place at the St. Andrew's Halls in Glasgow on 12th October 1883, when in a presentation on the innumerable proofs of a catastrophic inundation on a world wide scale, the Duke went far beyond even those who still clung to the Old Testament flood of the biblical lands. This prompted the publication of a satirical poem entitled 'The Deluge of Argyll', which appeared shortly afterwards in *Hardwicke's Science-Gossip*. The opening verse begins...

"What the Deluge once more? Yes, zounds
you may smile,
'Tis the Flood, not of Noah, but that of Argyll.
Not the same, but in wonders quite equalling that
Which stranded the Ark on Mount Ararat;
For its waters arose from a forty day's rain,
While Argyll's occurred from a burst in the main".

Undeterred by dwindling support, in 1885 the Duke of Argyll produced a greatly enlarged text entitled *Geology and the Deluge*. But by this time the Glacialists had convincingly won the day; and, despite the initial shaky start, by the close of the 19th century Scotland was leading the world in the interpretation of past glacial episodes.

ACKNOWLEDGEMENTS

My grateful thanks to Dr K.J.H. MacKay for reading through and commenting on a draft of this paper and to Norman Tait for the digital restoration of Ami Boué's 1820 geological map of Scotland which accompanies the text.

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Apart from several key papers relating to Loch Lomondside (marked*), the Selected Bibliography comprises recommended books and articles dealing with the history of geology and geomorphology in Scotland for further reading.

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JAMES CROLL: 19TH CENTURY PIONEER OF CLIMATE CHANGE

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INTRODUCTION

We currently live in an era of short-term research contracts and intense pressure to publish. Commitment to long-term strategy is difficult, and time necessary for thorough scholarship is simply not available. This is a particular problem in industry, where few references are made to previous work, let alone serious review of the relevance of 19th Century science to contemporary issues. As we stand at the turn of the 21st Century we need to reconsider our position as scientists in an increasingly sceptical society. Croll has much to teach us – and not simply about science.

At a deep level, Croll is the perfect anti-hero for the early 21st Century.

- We live in an era of short-termism: Croll once read a book 31 times before even a glimmer of light dawned.
- We are surrounded by spin doctors: no-one put words into Croll's mouth!
- Today, marketing and self-presentation are everything: Croll eschewed public appearances – he was reckoned to be the most reclusive scientist of his generation.
- This is the age of youth: Croll was decrepit and aged, even as a young man.
- Unfettered materialism is rampant: Croll was a philosopher.
- Above all, today's society needs to recapture its spiritual dimension: Croll never lost his.

Croll thought deeply and at great length about the factors controlling global climate, before proceeding to carry out the necessary critical calculations by hand: it took him ages! Nowadays it is easy to perform the calculations quickly on the computer, but we seem to have little time for fundamental thinking. In his own day, and shortly thereafter, Croll's scientific reputation was enormous; but it is quite exceptional for any of today's climatologists to refer to him, despite going over ground Croll covered exhaustively almost 150 years ago. So how was his scientific curiosity first aroused? And why does he merit a place amongst Glasgow's unsung heroes?

What emerges is a portrait of a man who, on the one hand, contemplated eternal truths but on the other, was a selfless and practical man for others. As his biographer Irons wrote...*"the man was greater than his work"*. I cannot recall this being said about many of Croll's contemporaries.

LIFE AND CAREERS

The child Croll confronts space and time

James Croll was born on January 2nd 1821 during a heavy snowstorm at Little Whitefield in rural Perthshire. His schooling was far from satisfactory: one of his teachers was "harsh and tyrannical; and the consequence was that I abhorred school, and, as might be expected, made very little progress." Shortly afterwards James was taken away to help on the family's smallholding and largely taught himself. He was a dreadful speller and had no interest in reading. The turning point came when, at the age of 11, he caught sight of the first number of the *Penny Magazine* in a shop window on March 31st 1832. He loved its large format and was especially attracted by the illustrations, became an avid collector, and eventually possessed the full set. There can be little doubt that James would have been impressed by the series of three supplements dealing with the weather, published in the second half of 1836. Croll wrote,"It would be difficult to find one with less aptitude for languages than I have", though one wonders if he knew that Charles Darwin was similarly deficient. Like Darwin, Croll was also in the habit of spending an hour or two every day alone, even from his early years. At the age of 12 he confronted himself with the enormity of time and space ..."I asked myself, What would there be, if there were no world? The ready answer, of course, was that there would be the sun, moon, and stars. What would there be, if there were no sun, moon, and stars? There would be God. But what would there be if there were no God? There would be nothing but empty space. But if there were no space, what would remain? **This question staggered me. I could not in thought get rid of space. Why could I not in thought annihilate space?"**

By the age of 16 James had already acquired a "pretty tolerable" knowledge of pneumatics, hydrostatics, light, heat, electricity and magnetism. He had longed to go to University, but with his family's limited means it was never going to be possible. He struggled throughout life with an almost permanent head pain, except in the height of summer: modest, shy, dry and with an almost speechless manner, his early career makes tragic reading.

Tea and Insurance

One winces as Croll moved from job to job in an effort to bring in an honest crust. A heavy and cumbersome man, he weighed out tea for a while... As a tee-totaller he tried opening a temperance hotel in Blairgowrie (which already had 15 hotels!)... He moved to Leicester and sold insurance.

Croll's own assessment of himself was probably correct. "Study always came first, business second; and the result was that in this age of competition I was left behind in the race." By the end of his life in 1890, aged 69, Croll had lived in no fewer than 19 different places and had had 15 jobs.

Rejected by the Hunterian

All Croll ever really needed, however, was space to think, and some job that was not too demanding for his fragile constitution. We learn from Lord Kelvin, in the biography he penned for the Royal Society, that Croll was one of 70 applicants for the assistant's position at the Hunterian Museum, the post actually going to his eventual collaborator John Young. It was, one suspects, not without some behind-the-scenes lobbying that he ultimately obtained in 1859 the lowly position of janitor at Anderson's College, from a field of 60: this was his 14th job. At last, aged 38, Croll's scientific work got going, aided by his brother who answered the door for him and made the fire up while he availed himself of the library facilities.

Fails Civil Service entrance exams

Croll's move from janitor at Anderson's College to assistant geologist in the Geological Survey office at Edinburgh was not without anguish. Croll was a man of nervous disposition and mature years. He had already – without a calculator - worked out the eccentricity and obliquity of the Earth's orbit back more than a million years. But rules are rules in the scientific civil service, and he was required to sit the entrance exam – and failed. By this stage, however, his glacial theory had won the support of both Ramsay and Archibald Geikie, respective directors of the Survey in England and Wales, and Scotland. The results of the exam were waived. So in 1867 Croll joined a Survey complement consisting of Director, District Surveyor, two Senior Geologists and six Assistant Geologists – he was essentially the aged office boy; though promoted to Geologist two years later.

This was by no means the end of his tribulations! During his 13 years in Edinburgh he was frequently off sick. Only once did he go to a concert, and twice to a scientific meeting. In 1873, the year after he received the Wollaston Fund from the Geological Society of London, he had to take nine months off. Writing had become very difficult for him, and he felt unable to accept the invitation to prepare the definitive article on climate for *Encyclopaedia Britannica*. His niece would often accompany him, writing down his thoughts "even on a tram-car" but he had become so weak he could muster only 30 minutes of coherent text per day, and this had to be dictated to an amanuensis.

Eventually Croll invalided himself out of the Survey as he felt he was no longer strong enough to do even his menial office job properly. He ended up a pauper with a minuscule pension, despite pages-worth of representations to Parliament by all the leading scientific lights of his day, like Lord Kelvin and Charles Darwin. Through all this Croll was never known even once to raise his voice and, as we shall see presently, he was unstinting in his support of his Survey colleagues, and could manage to be charitable to some of his sternest critics.

THE GLASGOW SCENE AND ITS INFLUENCE ON CROLL'S SCIENCE

Exciting debates were taking place in 1862 at the time of the founding of the Glasgow Geological Society. James Geikie gave a lecture on the Ice Age in Scotland, and James Croll was there. This stimulated him to produce his epoch-making paper on the importance of changes in ocean currents as determining global climate (Fig.1).

It was the 13th of his 92 publications, and laid the foundation of Croll's scientific reputation. From a letter in the British Library archive we learn that the paper was evidently published without editing ...

10th Feb 1864

Dear Sir,

I have forwarded your paper to Mr. Francis, altering nothing therein, Mr. Lyell of course, much kicking against the pricks. But it was thought desirable to allow a practical writer to state his own case.

Yours very truly

John Tyndall, [FRS, Superintendent of the Royal Institution]

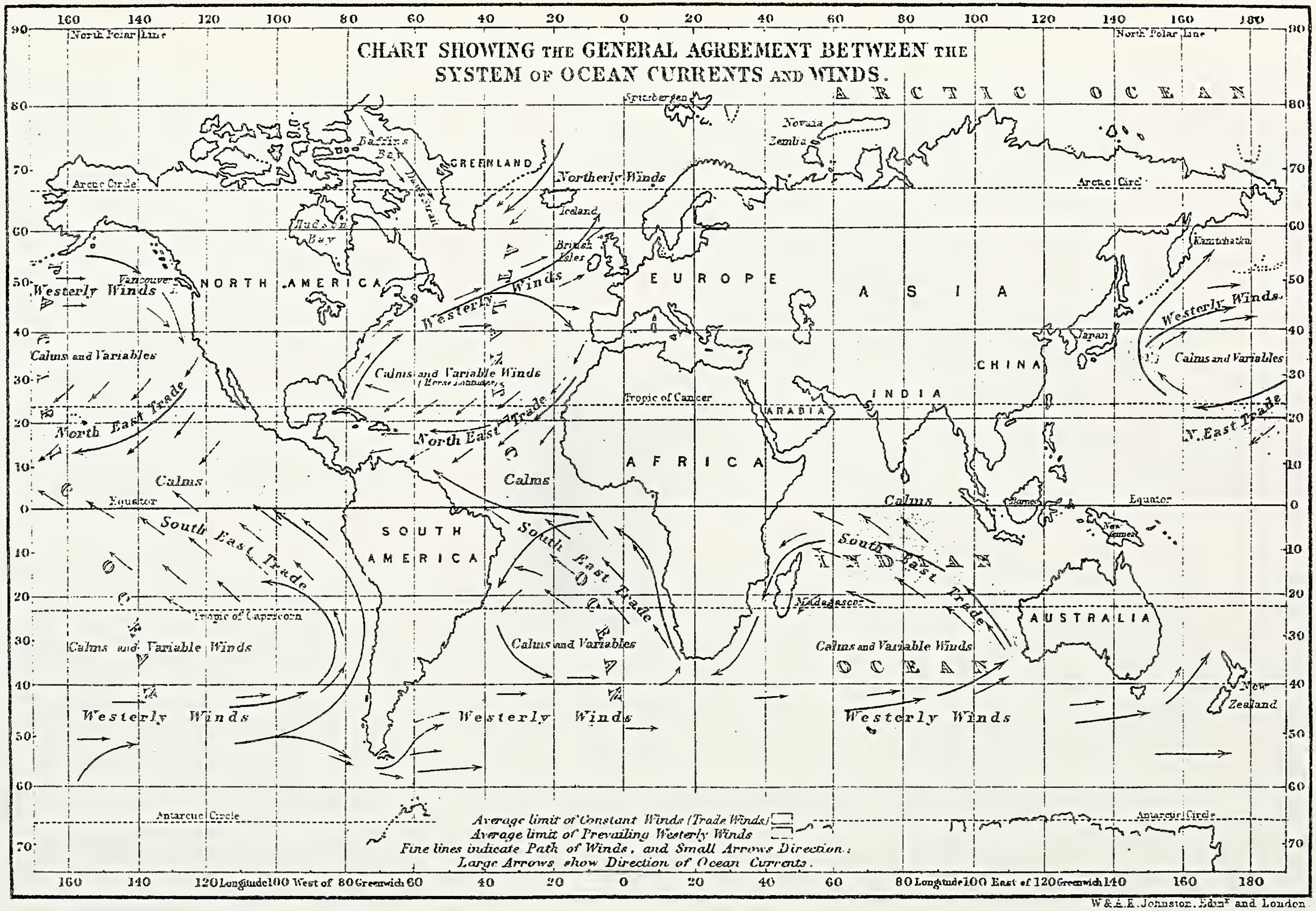


Fig. 1 Croll was convinced that winds controlled oceanic circulation (from *Climate and Time*, 1875)

At the time of writing Croll was unaware of Herschel and Lyell's work!

The paper generated its own correspondence, often with a strikingly modern ring to it, as in this letter from James Challis dated 30th August 1864. "In the Carboniferous...there was much more vapour and cloud in the Earth's atmosphere...the effect of this covering (or blanket) was to produce a more equable temperature than that now existing."

Geikie's lecture also spurred Croll on to his one-and-only piece of geological fieldwork, despite his horror of going out in the rain. Croll had, in fact, an acute dislike of both chemistry and, more particularly, geology: "to me they appeared so full of details and so deficient in rational principles".But in this one instance he had become fascinated by the buried channel of the Kelvin, and by contemporary exposures at Blairdardie. His interest continued after he left Glasgow for Edinburgh, when we see him trying to encourage a colleague (ultimately one of Croll's two Survey mourners) to earn some extra money.

Edinburgh, 28th March 1868.

Dear Mr. Bennie, I had a talk with Sir William Thomson this afternoon about the bores which he is busily engaged with at present. I told him...you were so perfectly familiar with the geology of the place. He stated that he was anxious to get some one to assist in taking the measurements of temperature...He is a very kind-hearted man. The **heart** is not so hard as the **head**. Somehow or other I love that sort of people.

Thirty years later it was another lecture in Glasgow - on this occasion given by Wyville Thomson, then recently returned from the *"Challenger"* expedition - that prompted Croll to expand upon his already beautifully argued section in *Climate and Time* about the thickness of the Antarctic ice sheet. This is one of the best examples of the lucidity of his scientific writing (even if he turned out to be wrong!). It is the more fascinating to read it in the copy housed in the Glasgow University Library. This is a handsome green volume entitled "Pamphlets" where Croll's

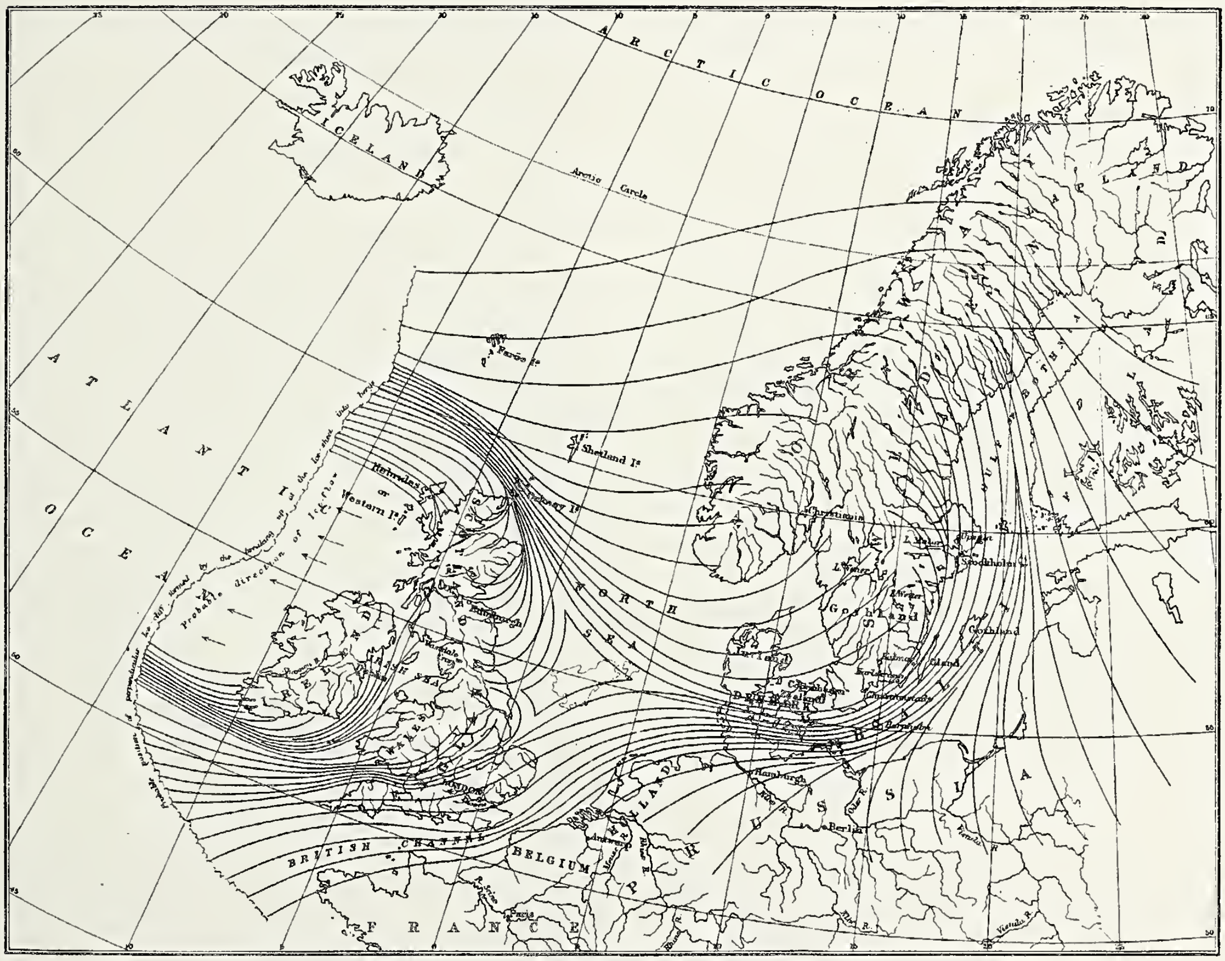


CHART SHOWING THE PROBABLE PATH OF THE ICE IN NORTH-WESTERN EUROPE DURING THE PERIOD OF MAXIMUM GLACIATION.

The lines also represent the actual direction of the striae on the rocks.

Fig. 2 Croll became a great advocate for the effects of North Sea ice in northern Scotland (from *Climate and Time, 1875)*

fundamental work lies alongside, appropriately, long-term climatological records for Bute and such ephemera as public disputes about the appointment of an organist and choirmaster on the south side of Glasgow!

Croll's map of the Quaternary ice sheet in NW Europe (Fig. 2) clearly shows the importance of North Sea ice, and its western limit is very close to the position subsequently determined by marine geophysical surveys by the British Geological Survey some 120 years later.

CROLL, THE BA AND THE BRITISH INSTITUTION

Croll eschewed publicity – almost as a matter of religious observance as much as because of his frail constitution. He reveals this quite candidly in a letter.

Edinburgh, 28th August 1871.
Rev. Osmond Fisher, M.A.

My dear sir, I did not, however, attend any of the meetings or excursions of the British Association. There are several reasons for that...My chief reason, however, was that I dislike all such public displays. The truth is, I have very little sympathy with the leading idea of the British Association, viz., that science is the all-important thing. I don't believe anything of the kind. There are more noble and ennobling studies than science. You can hardly expect one who has devoted twenty years of the best part of his life to the study of mental, moral, and metaphysical philosophy to have much sympathy with the narrow-mindedness of the British Association.

Philosophy is just as real a part of human knowledge as science; and the time is, I trust, not far distant when this will be universally recognised.

Had my house been a little more commodious, I should have been delighted to have seen you in Edinburgh.-I am, yours truly, James Croll.

Back in 1868 John Tyndall of the Royal Institution had asked Croll whether he was an FRS. Croll actually got round to seeking election in 1875 and was elected in 1876, the year the BA were to meet in Glasgow. A very old friend had invited him, but...

Edinburgh, 17th August 1876.
Dear Dr. Morrison, Many, many thanks for your very kind offer. Had I been coming through to the meeting, I should have been so delighted to stay with you.

I shall have a paper in Section A. but will not manage to be present. The older I grow, the more disinclined I feel to go out to public meetings of any sort.

I have not been at a scientific meeting for upwards of half a dozen of years. The real truth is, there is a cold materialistic atmosphere around scientific men in general, that I don't like. I mix but little with them. There is, however, indication of a reaction beginning to take place towards something more spiritual in science; and the day, it is to be hoped, is not far distant when religion, philosophy, and science will go hand in hand.

Before the cold weather sets in, I shall be delighted to come through to Glasgow and spend an afternoon with you.- With kind regards, I am, yours ever truly, James Croll

Which brings us nicely back to my introductory comments about what Croll has to teach us 125 years later at the start of the 21st Century!

CROLL, CLIMATE CHANGE AND CYCLICITY

We get an absolutely clear statement of how Croll saw the subject towards the end of his life: "The most important problem in terrestrial physics, in so far as regards geological and palaeontological science, and the one which will ultimately prove the most far-reaching in its consequences, is, What are the physical causes which led to the Glacial Epoch and to all those great secular changes of climate which are known to have taken place during geological ages?" Note the truly prophetic tone.

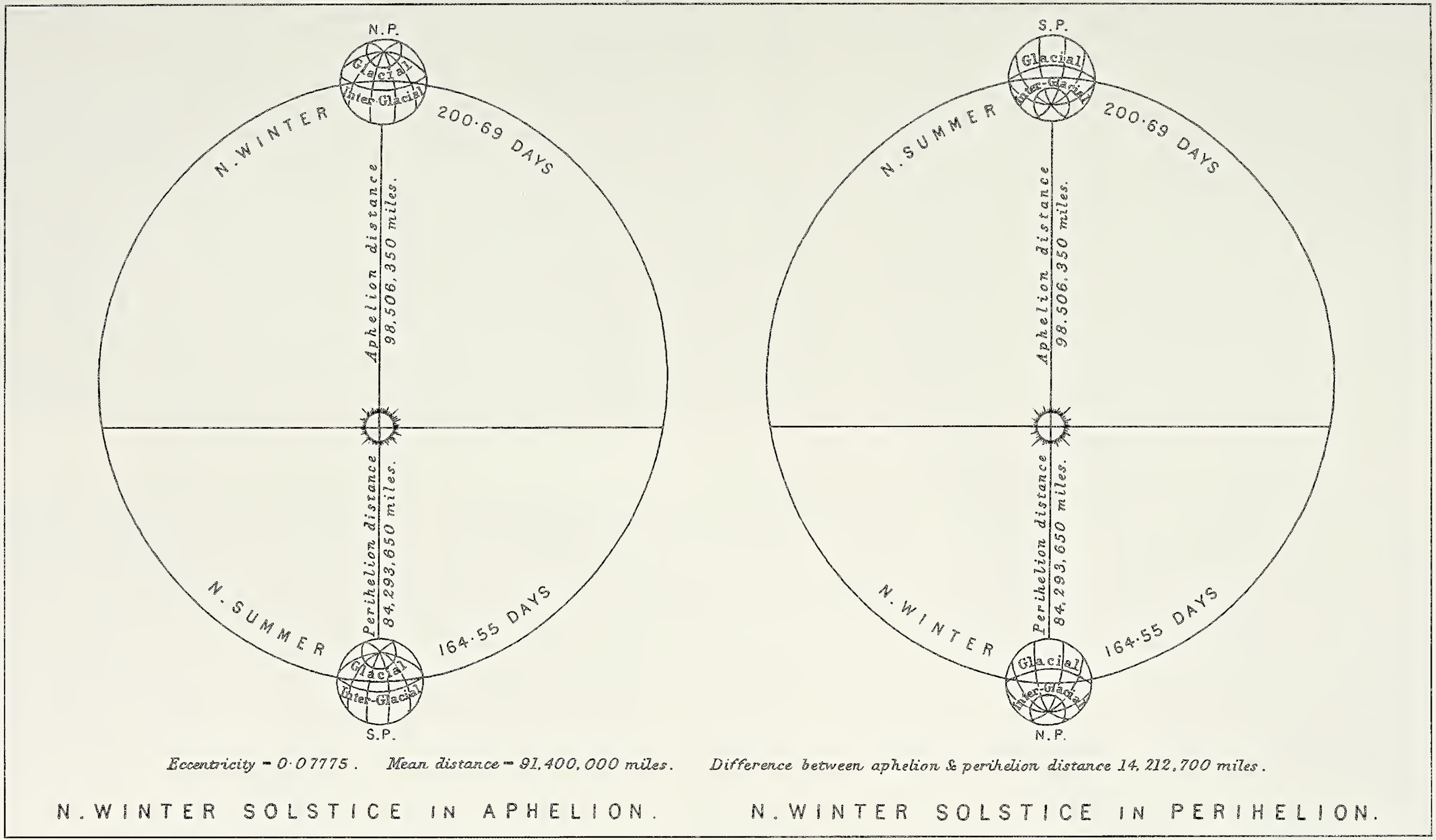
Croll (1864) is the paper today's climatologists ought to refer to. This is where he established the priority of his ideas, most notably in attributing the forcing of glaciation to an extra-terrestrial cause, via eccentricity of the Earth's orbit (Fig. 3). He also deals fully with other orbital cycles, to an extent that makes it outrageous for the scientific community in general to speak of "Milankovich cycles". (See the reference list for a bibliography). A rare exception occurs in Seibold and Berger's undergraduate textbook *The Sea Floor* (1982) where the authors speak of "The Croll-Milankovitch Theory of the Ice Ages".

Despite the novelty of his ideas on cyclicity, Croll himself saw his work in broader terms:

"I prefer to term the theory the Physical Theory rather than the Eccentricity Theory."

Throughout his career Croll had a running battle with Carpenter over the main control on global ocean circulation. Croll was a wind man whereas Carpenter believed in salinity/density. Today we acknowledge both determinants, but on balance the significance of wind is seen to be greater. We can appreciate this by comparing the effects on ocean temperature of the passage of hurricanes. Their tracks in 1999 (Fig.4) show how they reinforce the general circulation – there is very close correspondence with Croll's map (Fig. 1).

FRONTISPIECE.



W & A.K. Johnston. Edinʳ and London

Fig. 3 Croll's frontispiece to *Climate and Time* (1875) : the Earth's orbit as a fundamental control on glaciation : ignored in preference to Milankovich.

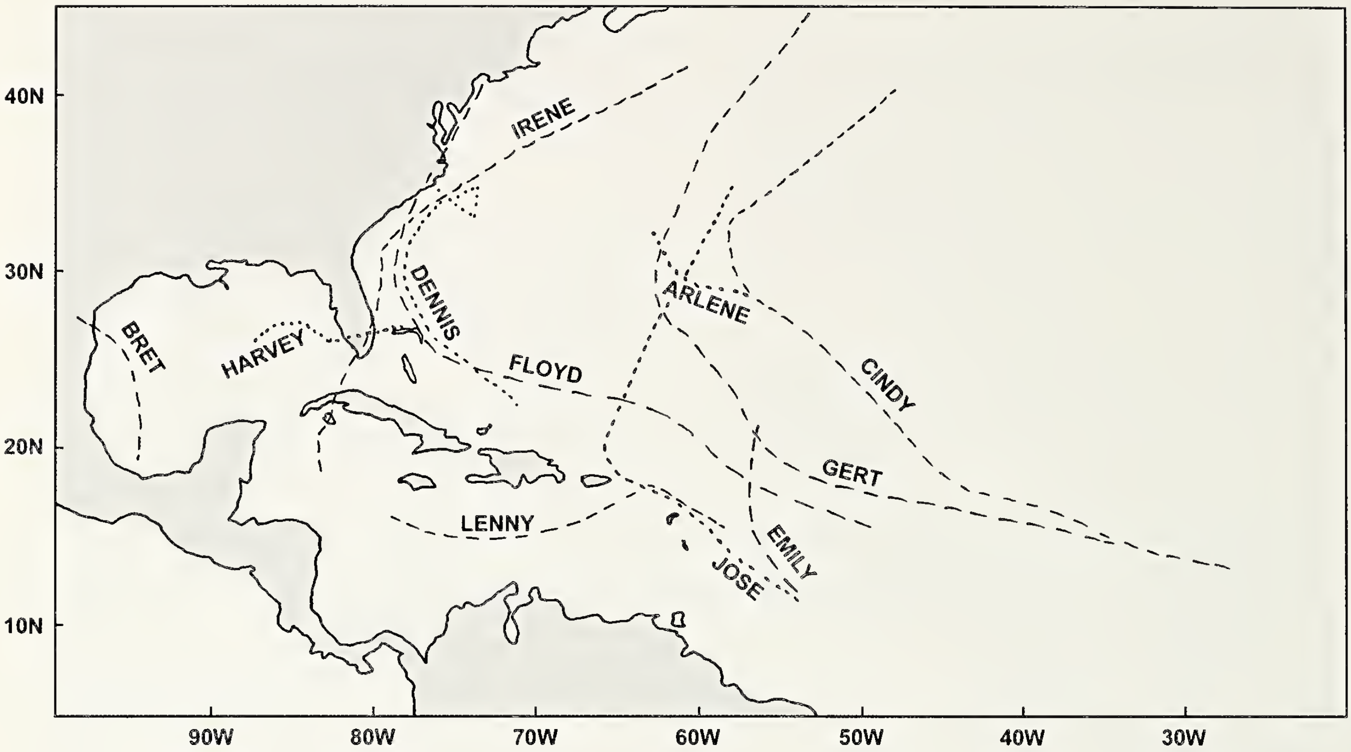


Fig. 4 Cyclone tracks in the North Atlantic for 1999, redrawn from satellite data.

Croll was also alive to the potential significance of palaeogeography, as he discusses in respect of the Gulf Stream:"A very slight change in geographical conditions, such as the opening of communication between the Gulf of Mexico and the Pacific, would have greatly diminished, if not entirely destroyed, that stream." The positioning of land masses exerted an early influence on Croll's thinking, as his figure showing the current deflection imparted by Cap St Roque demonstrates (Fig.1). It also left a lasting impression on Horne, his close friend, official mourner and Geological Society of London biographer:"But the cause which, above all others, tends to produce changes of climate is the deflection of ocean currents....He has left behind him a brilliant series of researches, of which Scotchmen may well be proud".

CROLL AND GEOLOGICAL TIME

If remembered at all today, Croll is generally connected with the explanation of ice ages; but he had a profound effect on his contemporaries in other vital scientific areas. Take this letter from Darwin, for example:

Down, Bromley, Kent

19th September 1868

Dear Sir, I hope that you will allow me to thank you for sending me your papers in the *Philosophical Magazine.* I have never, I think, in my life, been so deeply interested by any geological discussion. I now first begin to see what a million means, and I feel quite ashamed of myself at the silly way in which I have spoken of millions of years...I thank you cordially for having cleared so much mist from before my eyes. With sincere respect, I remain, dear sir, yours very faithfully,

Charles Darwin.

This significant, and overlooked, aspect of Croll's work brought him very much into contact with Lord Kelvin. In *Climate and Cosmology* (1885) Croll sets the scene early on by stating: "We fail to give the element of time due influence in our speculations". In the substance of the book several chapters are devoted to geological time, including in Chapter XVII a wonderful discussion on 'Testimony of Geology as to the Age of Life on the Globe'. "The utter inadequacy of a period of 20 million years for the age of our earth is demonstrable from the enormous thickness of rock which is known to have been removed off certain areas of denudation".

Croll goes on to apply present-day Mississippi rates to the Scottish Devonian and Carboniferous sequence,ultimately generalizing "at least 90 my as the age of the stratified rocks".

Later, in Chapter XX, he estimates.."nearly 500 my since the start of Earth's geological history", an age more than nine times greater than that proposed by Lord Kelvin in his calculation based on the sun's heat (in the absence of a knowledge of radiogenic heat). Croll, though not counting himself a geologist, nevertheless shows a sound understanding when he states: "the longer we suppose the pre-Cambrian periods to have been, the shorter must we suppose the post-Cambrian to be".

In fact, if he'd taken Lyell's ages of 20my since the Early Miocene (correct according to the current geological time scale) and 60my since the base Eocene (very close) and applied his logic in reverse, he would indeed have come close to our present understanding – but at a cost of alienating himself even more from Lord Kelvin's position!

In Chapter XIX he outlines his concept of: "geological time measurable from astronomical data" - precisely the subject of recent Geological Society of London special publications, in none of which is Croll's vision given credit – it's all Milankovich! Croll's ages for the Tertiary are now seen to be too young, but he nevertheless established his method quite clearly by the backward calculation of the various orbital motions.

CROLL, THE CLYDE AND GLOBAL EROSION RATES

Later in his 1868 letter to Binnie, quoted above, Croll returns to the west:

"Mr. Geikie stated that Mr. Dougall had found that the Clyde, at Rutherglen Bridge has, during the flood, 1/800 of sediment in suspension. Is it 1/800 in weight? Is it our friend Mr. M'Dougall of the Geological Society? If so, get the particulars from him".

We get to the bottom of this in *Discussions on climate and cosmology*, where we learn that it is by bulk. Croll develops calculations on the Mississippi and Ganges, having again been inspired by Geikie: he is especially interested in methods of measuring the rate of subaerial denudation. We learn that in the Nith catchment the rate is 1 foot in 4723 years, whereas the Po is 1 foot in 729 years. The Tay emerges as carrying three times as much water in proportion to its drainage area as the Mississippi – and it has been carrying even more in recent years, as it has responded to climate change more than any of the other Scottish rivers.

Croll's work in this area anticipated by 100 years the worldwide review by Milliman and Meade (1983), and his quote:"Every river system possesses a definite amount of carrying-power"...places him clearly on the path that led ultimately to George Fleming's benchmark work on the Clyde.

CROLL , THE BURIED KELVIN AND GLACIAL SEA-LEVEL

Croll's interest in the buried channel of the Kelvin continued to mature, and he integrates it into a discussion of evidence for a continental period in Britain in Chapter XXIX of *Climate and Cosmology*. Records from 250 borings were available to him, and he was most struck by the fact that the trough was not everywhere a hollow but was often an immense ridge of sand, gravel or boulder clay rising 150 to 200 feet above present-day sea-level. He notes that the trough is partly filled with marine deposits but, in a lengthy discussion, dismisses the notion that the sea could have eroded the valley. Again, he anticipated much of the discussion that has taken place over the last 20 years on sequence stratigraphy and changes of relative sea-level. "There is something of far more importance attached to this hollow than the mere fact of its being an old watercourse. For the fact that it enters the Firth of Forth at a depth of 260 feet below the present sea-level, proves incontestably that at the time this hollow was occupied by a stream, the land must have stood at least between 200 and 300 feet higher in relation to the sea-level than at present."

Croll thus unequivocally identified what we would now term the "glacial low-stand"; but a full understanding eluded him, for he made no allowance for isostatic effects following ice-sheet melting. His eustatic thinking was spot on, however. He recognised coal as an interglacial (i.e. high-stand) deposit, and stressed that coal-beds necessarily imply oscillations of sea-level.

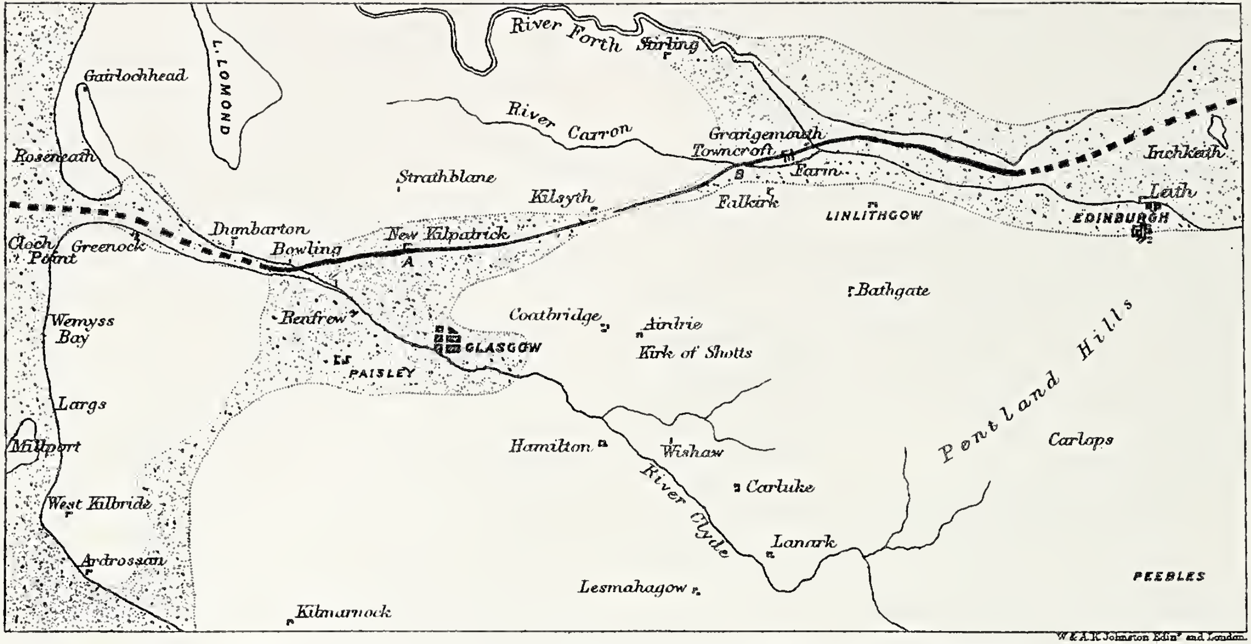
CROLL AND CONTEMPORARY ISSUES

One of today's most urgent scientific debates is about the long-term significance of recent flooding. We are living with the results of intensified North Atlantic circulation. There is now a long enough time-series of sea-surface satellite data - radar altimetry and temperature – to show that an increase in mean wave height of 0.5m has occurred together with higher sea temperatures. The resulting increased precipitation in NW Britain is dramatic proof of Croll's theoretical calculations from first principles, which formed the basis of his physical theory.

The relationship between changes in the pattern of ocean currents and climate change, which we now take for granted, was also worked out 140 years ago by Croll. Today, however, we are very prone to fall hook-line-and-sinker for the elegant hypothesis, to climb on the band-wagon, especially so far as obtaining funds is concerned. I'm sure, were Croll alive today, he would be especially sceptical of claims about **global** warming: he was at great pains to point out that there are sound physical reasons why northern and southern hemispheres should differ.

We would also be well advised to remember how little we actually know about the paths taken by today's currents at different levels within the ocean. Radioactive tracers in the Greenland Sea, for example (Watson *et al.*, 1999), suggest that, elegant though it is, the North Atlantic Climate Switch hypothesis may not ultimately be confirmed by automatic current-tracking buoys. The necessary south-flowing stream was limited to a very restricted region, much of the flow heading northwards between Greenland and Spitsbergen. Even these first experiments show that we need to be wary of the simulated circulation patterns generated by so-called high resolution ocean circulation models.We still don't have sufficient data to provide valid model input!

PLATE VII.



W & A.K. Johnston Edinʳ and London.

CHART OF THE MIDLAND VALLEY, SHOWING BURIED RIVER CHANNELS.

The blue parts represent the area which would be covered by sea were the land submerged to the extent of 200 feet. The heavy black lines A and B represent the buried River Channels.

Fig. 5 Croll's map shows not only the buried river channels, but also (shaded) the area that would have been covered by the sea at a height of 200 feet above present-day sea-level (from *Climate and Time*)

We can learn from Croll…

- to be less phrenetic and short-term ourselves
- to be more committed to acquiring long-term physical, chemical and biological oceanographic data
- to help support the endeavours of others
- to show greater dedication to fundamental understanding, rather than to be slaves to technology

We should be encouraging tomorrow's scientists to build on the strong spiritual component to Croll's work, alongside the development of their basic science. I do not believe we will find our youngsters lacking in spirit, but unless the scientific spark is first kindled, where will the future custodians of Earth come from? It is our mission at Glasgow Science Centre to kindle that spark. May our spirit be as strong as Croll's and our dedication as deep.

ACKNOWLEDGMENTS

I am grateful to Dr Graham Durant for first suggesting to me that Croll might be worth a deeper look. Malcolm Allan of Strathclyde University kindly looked out rare books.

SOURCES

In the British Library at St Pancras in London is a bound volume of Croll's correspondence – BL 41,077. This was purchased at Sotheby's on the 10th April 1924 as Lot 189. Irons (1896) is the only extended biography, and this includes copies of letters not found in the British Library. In the Appendix will be found a full list of Croll's 92 publications, and copies of Lord Kelvin's *Nature* obituary (published on Christmas Day 1890) and that by Horne to the Geological Society of London (published on 19th February 1891).

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There are some ocean and climate animations available at:
http://www.ge.ucl.ac.uk/awayne/polar/climate.html
Bibliography on Milankovich cycles: see the following web site
http://ds.pipex.com/town/parade/au08/clbib.htm

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NATURAL REGENERATION OF LIMES (*TILIA SPP.*) IN SCOTLAND:

widespread but less numerous in 2000

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ABSTRACT

The re-appearance in the year 2000 of lime tree seedlings towards the northernmost limit of their range, in the central Scottish lowlands especially in the north and west of Glasgow, is recorded and discussed. Attention is drawn to the widespread nature of this regeneration and also to the diminished number of seedlings compared to previous years.

INTRODUCTION

The remarkable outburst of seedlings of lime trees (*Tilia spp.*) in the Glasgow area in 1997 (Gray *et al.*, 1999) was previously unrecorded and not thought to happen so far north as Scotland. Since then further regeneration was observed in 1998, 1999 (Gray & Grist, 2000) and now again in 2000. We now report observations by the authors and others of lime regeneration in Glasgow and elsewhere in Scotland in 2000. In that year the numbers of new seedlings of all three locally found lime species were much fewer than in previous years suggesting germination from seed fertilised in 1997, the last hot summer, or earlier (1995).

REGENERATION IN 2000

Our earliest observation of lime seedlings (common lime, *Tilia x europaea*) was on 19th March 2000, in the same location, the garden of 9 Victoria Circus, as in 1999. Two were noted (Table 1).

In the year 2000 the number of sites where regeneration was observed was 25, as in 1999, although some of the locations were different. The numbers of seedlings, however, were less than in 1999 and 1997. For instance, in the garden at Hyndland Court recorded in our previous paper (Gray & Grist, 2000), 62 seedlings appeared, 22.5% of the 275 found in 1999. Forty seven of them emerged in the $64m^2$ plot mentioned in that paper, 20% of the 235 in 1999, at a density of approximately $0.7/m^2$ ($3.6/m^2$ in 1999). The peak time of emergence was again from the end of April through the first half of May. All had the normal two cotyledons, unlike the previous year when a few with three cotyledons appeared.

Since the last hot summer (1997), on the basis of 18 months from fertilisation to germination, 1999 might have been the last year for seedlings to emerge. In the event, regeneration of all three species was observed. The figures do show that the greatest amount of regeneration occurs 18 months after fertilisation, i.e. large numbers of seedlings in 1999 and 1997 after the hot summers of 1997 and 1995 respectively. However, a few seeds clearly take longer than 18 months to germinate and indeed it has been pointed out (Pigott, 1991) that some seeds can take as long as 7 years to germinate.

Both large leaved (*T. platyphyllos*) and small leaved (*T. cordata*) limes showed a fall in the number of both locations and seedlings compared to 1999; but those seedlings that did germinate presumably developed, as argued above, from fertilisation in 1997.

It has been reported from the Milngavie area (M.H. Hansen, personal communication) that two lime seeds planted in pots in the autumn of 1997 germinated in the spring of 2000. Approximately 20 seeds had been planted in each pot. A few seedlings of large leaved and common limes were also reported from that area. Considerable regeneration was found there in previous years (Gray *et al.*, 1999).

Outwith the Glasgow area our attention was drawn by T. Norman Tait to seedlings he found under pavement grills surrounding cherry trees (*Prunus* sp.) outside the supermarket just east of Renfrew Cross. There we counted 43 seedlings and six survivors from 1999. The parent common limes were roadside trees planted a short distance to the south. In the Royal Botanic Garden in Edinburgh, under the large leaved lime where 63 seedlings had been found in 1999, 2 seedlings were observed in ground that had been left uncut.

The above evidence therefore confirms that, from west to east in central Scotland's lowland belt, there was regeneration of lime seed fertilised in hot summers at least three and perhaps five years ago.

TEMPERATURE

Each of the 1999 Mugdock monthly mean temperature maxima adjusted to sea level in our previous paper (Gray & Grist, 2000) should have read 1°C higher (Table 3). The July and August figures (19.9°C and 19.1°C respectively), however, were still below the 20°C threshold. Data for the year 2000 show that the adjusted Mugdock temperatures for July and August are also less than 20°C and so 2000 is not categorised as having a 'hot summer'. On the basis of this and the temperatures for 1999 no explosion of lime seedlings is anticipated in 2001 or 2002.

Table 1: Sites of natural regeneration

a) Tilia x europaea

9 Victoria Circus	19/3/00	2 seedlings
Hyndland Court, plot A.	4/4/00	2 seedlings Total for 4/4 18/6 = 47 seedlings (whole garden total=62)
9 Victoria Circus	16/4/00	Total for 19/3 - 16/4 = 8 seedlings, 3 x '99 survivors
3 Sydenham Road	24/4/00	2 seedlings, 1 x '99 survivor
Linfern Road (mid).	24/4/00	3 seedlings
21 Victoria Circus	24/4/00	2 seedlings
6 Prince Albert Road (front)	24/4/00	2 seedlings
Lorraine Road SW corner	28/4/00	1 seedling
Lorraine Terrace	28/4/00	1 seedling
Sydenham Road/Linfern Road N corner	28/4/00	3 seedlings
3 Sydenham Road	28/4/00	1 + seedling
6 Prince Albert Road (front)	28/4/00	8 seedlings
5 Victoria Circus	28/4/00	1 seedling
Prince Albert Road S.Side W.end	30/4/00	2 x '99 survivors
6 Prince Albert Road (back)	30/4/00	2 seedlings
Notre-Dame school garden	1/5/00	2 seedlings
Botanic Gardens under hybrid near 'Petiolaris'	1/5/00	1 seedling
10 Victoria Circus	2/5/00	1 seedling, 4 x '99 survivors
6 Prince Albert Road (back)	4/5/00	12 seedlings
BT Sydenham Road	2/5/00	6 seedlings
BT Linfern Road	2/5/00	4 seedlings
Terregles Avenue	3/5/00	1seedling
BT entrance gravel	7/5/00	1 seedling
72 Crown Road North	17.5.00	1 x '99 survivor
Hughenden rugby stand	17/5/00	1 x '99 survivors
Great Western Road N side, Balgray	17/5/00	6 x '99 survivors
Balgray, W gate	16/6/00	1 x '99 survivor, 1 x '98 survivor
3 Sydenham Road	18/6/00	1 x '99 survivor

b) T. platyphyllos

Marchmont Terrace	24/3/00	1 seedling, 1 x '99 survivor
Kingsborough Gardens	5/4/00	2 seedlings, 2 x '99 survivors, 5 x '98 survivors, 1 x '97 survivor, 2 x c.7 year old survivor
Milngavie spoil heap		2 saplings

c) T. cordata

Kingsborough Square	17/5/00	1 seedling, 5 x '99 survivors
Auchenhowie Wood		2 saplings, 1 stool

Table 2: Summary of lime regeneration in 2000, 1999, 1998 and 1997

Species	Survivors '00	Survivors '99	Survivors '98	New in '00	New in '99	New in '98	New in '97
T.x europaea	21 (0 saplings)	7 (0 saplings)	24	124	Several 100's	>50<100	100's
T. platyphyllos	13 (incl. 3 saplings)	12 (incl. 6 saplings)	36	3	145	13	>40
T. cordata	8 (incl. 3 saplings)	2 (both saplings)	3	1	20	2	0

Table 3: Monthly mean temperature maxima (°C.)

(Mugdock* 2000 & 1999, Abbotsinch 1998 to 1996 and Renfrew 1995)

	2000	1999	1998	1997	1996	1995
June	16.9	16.6	16.7	17.9	18.0	19.5
July	19.5	19.9	17.9	**20.3**	19.2	**20.8**
August	19.3	19.1	18.5	**21.6**	**20.2**	**22.8**
Sept.	16.7	17.6	17.0	16.6	17.7	16.7

***Mugdock (160m. a.s.l.) amended using the lapse rate of 10°C. per 160m.**

SURVIVORS

All survivors counted in the year 2000 were observed in spring, i.e. all had survived at least one winter. Although a few common lime seedlings survived one winter, none was found to have survived longer than this except a few in pots in Hyndland Court, Prince Albert Road and in Milngavie (Table 2).

Large leaved lime seedlings have been found which are older than this. Furthermore two hedge saplings are known in the west end of Glasgow. At least two saplings remain on the mineral lime spoil heaps in the Milngavie area, although one known in a garden was removed but not before a section was taken (M.H. Hansen, personal communication).

Small leaved lime survivors beyond one year old have not been found in the west end of Glasgow but a few were reported by M.H.Hansen from the Milngavie area: at least one sapling remains in Craigton wood in which two were previously recorded (Gray *et al.*, 1999). He also reported having found in Auchenhowie wood two small leaved lime saplings as well as a sapling the origin of which is thought to be common (hybrid) lime crossed with small leaved lime.

DISCUSSION

Lime tree regeneration by seed has become an established, if inconsistent, phenomenon in the Scottish lowlands since the hot summers of 1995 and 1997. Evidence documented in this and previous papers indicates that such regeneration has occurred over many years. How widespread this regeneration was remains uncertain. It is clear, however, that experimental work by M.H. Hansen in the 1990's stimulated much more attention to be paid to this phenomenon than had been paid before.

ACKNOWLEDGEMENTS

We are grateful to Professor C.D. Pigott for his helpful advice and to M.H. Hansen for information about his observations and experimental work. We thank Mike Matthews of the Met. Office for his detailed comments and for making temperature data available to us.

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AN UNUSUAL ASSEMBLAGE OF PLANTS AT GARTCOSH, LANARKSHIRE (VC 77)

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INTRODUCTION

A site at Gartcosh, occupying about a quarter of a 1km square, became involved in steel making about 1870. Initially it opened for puddling, i.e. iron ore being transformed into pig-iron. Shortly thereafter, rolling mills were constructed for the production of sheet steel. At the height of production there were eleven mills in the complex, but they were gradually closed, the last about 1960. A strip mill opened in 1961/2. Before its construction, the ground was irregular, so the tops were sliced off the higher areas and the material used to fill the hollows. This mill closed in 1986.

One of the processes involved in the steel production was the removal of slag from the surface of the material. To achieve this, the iron was immersed in hydrochloric acid (pickling), the fluid subsequently being diluted and run off into a burn. Since the mid 1990s the complex has been gradually prepared for redevelopment by demolition of the buildings and the construction of access roads.

PLANT RECORDING

I was initially invited to record at the site in 1997 by Bill Brackenridge, ecologist with the North Lanarkshire Council, because an initial survey had noted the presence of slender spike-rush (*Eleocharis uniglumis*) and round-fruited rush (*Juncus compressus*). At that time there was barish ground near the residual buildings while further north there was grassland in which were located many pools of varying size. I was surprised to discover that at the extreme north end of the site there was the woodland of the abandoned Woodneuk Estate, in which an unsuceessful attempt had been made to create a feature garden with plants from the 1988 Glasgow Garden Festival (Macpherson, 1998). I had, in fact, gone into the upper part of the site in 1996 and early 1997 while recording at Woodneuk.

Subsequently I have paid frequent visits, mostly on my own but sometimes in the company of Mark Bates of Heritage Environmental (1998 & 1999) who drew my attention to a small colony of adder's-tongue (*Ophioglossum* spp.), tubular water-dropwort (*Oenanthe fistulosa*) and least bur-reed (*Sparganium natans*). The adder's-tongue is reminiscent of small adder's-tongue (*Ophioglossum azoricum*) but I have been unable to coax the experts to undertake appropriate laboratory testing. The average plant height is 9cm, the sterile blade of 4cm long being narrow and pointed, and the average sporangia bearing part of the spike 1.5cm. In 1998 Cameron MacIver discovered an unusual *Scirpus*, the subject of a separate report. I recorded a total of 197 plants.

The relatively bare ground in the neighbourhood of the residual buildings has deposits of shale-type material and artificial substrates. In this area 19 species were noted. In particular, there was an abundance of common centaury (*Centaurium erythraea*. Included in the list of smaller plants were small toadflax (*Chaenorhinum minus*), fairy flax (*Linum catharticum*) and biting stonecrop (*Sedum acre*), while included in a larger group were teasel (*Dipsacus fullonum*), viper's-bugloss (*Echium vulgare*) and white melilot (*Melilotus alba*).

A few small pools are relatively bare with pale coloured mud, presumably indicating toxic deposits, but the wetland areas and ponds are in the main well vegetated. In these habitats 27 species were recorded (excluding rushes and sedges). Of special note were narrow-leaved water-plantain (*Alisma lanceolatum*), slender spike-rush (*Eleocharis uniglumis*), purple-loosestrife (*Lythrum salicaria*), tubular water-dropwort (*Oenanthe fistulosa*), a large patch of greater spearwort (*Ranunculus lingua*), least bur-reed (*Sparganium minimum*), blue water-speedwell (*Veronica anagallis-aquatica*) and four species of orchid.

Of the ten *Carices*, the rarest was false fox-sedge (*C. otrubae*), while of eight rushes, the outstanding one was round-fruited rush (*Juncus compressus*). A number of small colonies of the latter are present, probably the only extant site for the plant in Lanarkshire.

None of the 19 grasses was of particular note. Of the 14 trees, small-leaved lime (*Tilia cordata*) was suckering. *Alnus cordata* and *Salix lucida* (both new vice-county records) must also have been planted, but the former, especially, now appears very much "in the wild". On a sloping bank between a track and a wet area there is a colony of the silvery leaved variety of creeping willow (*Salix repens* var. *argentea*).

Most of the 14 alien herbaceous plants were probably introduced but now appear in a wild state. There are three Michaelmas daisy taxa (*Aster* spp.), Jacob's-ladder (*Polemonium caeruleum*) and one plant of chives (*Allium schoenoprasum*) in an area of grassland.

DISCUSSION

The botanical interest centres mainly on the wetland areas and pools. Tubular water-dropwort and slender spike-rush are new vice-county records. The former is to be found in coastal areas in Scotland, as is the latter for most of its distribution in the British Isles. The sites of round-fruited rush are also often near the sea and in the *Atlas of the British Flora*, Perring and Walters (1962) give only one extant Scottish record and as stated above it is likely that the Gartcosh site is the only present record in Lanarkshire. It is possible that the adder's-tongue is stunted as a result of chemicals in the habitat, but were it to be small adder's-tongue, then this again is very much a coastal plant. *Salix repens* var. *argentea* tends to be a plant of dune slacks.

The blue water-speedwell is not known to occur elsewhere in the north of VC 77 but has three sites in the south, while lesser bur-reed has only three other known sites in Lanarkshire, one in the north and two in the south. One can only speculate that the above rarities were brought to the site accidentally, either with material used in the construction of the steel processing site or with material used in the manufacturing process. When PowerGen lodged a bid to build a gas-fired power station on the site there was considerable local opposition because it was considered that this would have discouraged other industries and provided only 30 jobs. The application has been rejected and Lanarkshire Development Agency expects that the site can give employment to up to 5000 individuals. If this prediction is fulfilled it will have considerable impact on the plant life. Special enclosures have been constructed for the protection of colonies of great crested newts which inhabit the site. Some of the rare plants are within these areas. The other rarities are not under immediate threat but could become so as redevelopment takes place. However, the ecologists are aware of the plant interest and it is intended that the rarities will, if necessary, be translocated within the site.

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PLANT RECORDING AT BOGLESHOLE

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INTRODUCTION

Bogleshole is an intriguing name. It conjures up a hollow in relation to ghosts or witches, but in reality was the name of an estate, owned by the Bogle family from the 16th century (Walker *et al.*, 1988). The 1km square 26/63 61 has the River Clyde running through in a more-or-less north-south direction and crossed by the Bogleshole Road and Rail Bridges (Fig. 1). Strictly speaking, only that part to the east of the river was the old estate, but since we began recording in the area in 1987, we have referred to the whole 1km square as the Bogleshole square, Lanarkshire (VC 77).

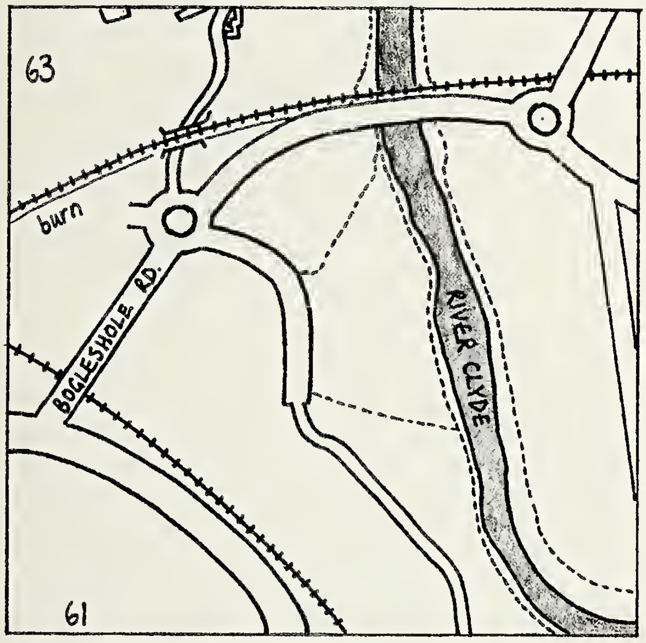

Fig. 1 Map of Bogleshole

When we first developed an interest in the area in 1987, most of the land to the west of the river, north-west of Bogleshole Road, was derelict, with a large central hummnock. Until the autumn of 2000 it was used extensively at weekends by youngsters for dirt-track motor bike riding, an unusual hazzard for recorders! To the north there is a stream with semi-natural woodland. The ground to the south-east of the road was used for grazing by horses. It was mainly flat but contained a wet hollow into which hundreds of tyres had been dumped. On the east side, trees have been planted along the road side and there is rough grassland leading up to the fenced off Cambuslang Industrial Estate. Again, until the autumn of 2000, the river banks were well wooded and had an interesting flora. During our recording period there has always been a small industrial complex north of the railway with much surrounding rough grassland.

Recently, machinery has been brought in, the top soil on either side of Bogleshole has been removed and the hummock flattened. The hollow has been infilled and the vegetation stripped from both sides of the river, upstream from the bridge.

RECORDING

In total we recorded 273 different taxa. Grasses were well represented, 24 species having been recorded. However, rat's-tail fescue (*Vulpia myuros*) was the only one of any rarity, having been recorded in only eight of the 90 tetrads in the Glasgow Rectangle, as defined in *The Changing Flora of Glasgow* (Dickson *et al.*, 2000), and in only eight quadrants in the whole of Lanarkshire.

Surprisingly, with regard to sedges, rushes, wood-rushes and horsetails, we recorded only one of each. The first persists, there being a stand of pendulous sedge (*Carex pendula*) in the semi-natural woodland by the burn.

Recorded from the banks of the Clyde were the natives narrow-leaved water-plantain (*Alisma lanceolatum*), black mustard (*Brassica nigra*) and wood stitchwort (*Stellaria nemorum*), while among the aliens were giant hogweed (*Heracleum mantegazzianum*), Indian balsam (*Impatiens gladulifera*) and fringecups (*Tellima grandiflora*).

On barish ground the thyme-leaved sandwort (*Arenaria serpyllifolia* spp. *leptoclados*) was recorded in one, and field madder (*Sherardia arvensis*) at four different sites within the square. In the Glasgow Rectangle, only two other tetrad records were made of the former during recent recording and three of the latter for which there are no other Lanarkshire records. At one time there was an abundance of large-flowered and intermediate evening primroses (*Oenothera glazioviana* and *O.* x *fallax*), but reduced now to there being only a few track-side plants. There are only two other records for each of these taxa in the Glasgow Rectangle and no others in the vice-county.

DISCUSSION

Plant recording in an area like Bogleshole typifies such work in the vicinity of habitation and adjacent to industrial complexes. The flora recorded had been relatively abundant and diverse, and included a significant number of local rarities. No major land change had occurred over the twelve years between 1987 & 1999. Accordingly, the flora had remained fairly stable, though, in view of the habitat, each year we recorded some changes. However, because of the preparation for major re-development as described above, at the time of our last visit in mid October 2000, only about 1/5th of the surface remained as it had been over the recording period, with the result that only the plants of roadside, woodland and rough grassland are still present.

Towards the end of this last visit, we were on the highest part of the rough grasland, when overhead we noticed an object travelling along just under the cloud base. It seemed to have two components, one below the other. The senior author thought that it might have been something used for weather forecasting, while the most junior insisted that it was a "UFO". Perhaps it was the witch on her broomstick, like the plants, forced out by the developers, and going to pastures new!

ACKNOWLEDGEMENTS

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THE STATUS OF FRESHWATER CRAYFISH IN SCOTLAND IN THE YEAR 2000

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ABSTRACT

Although no freshwater crayfish are native to Scotland, at least four populations are known to be established here now. Two are of the white-clawed crayfish *Austropotamobius pallipes*, native to England and other parts of Europe and two are of the signal crayfish *Pacifastacus leniusculus*, native to North America. The significance of these populations is discussed.

INTRODUCTION

It is believed that no species of freshwater crayfish is native to Scotland and thus any found here have been introduced from elsewhere. One population has been known in the north of Scotland for many years and recently several other established populations have been identified. The objective of this paper is to assess the populations which have been verified so far and discuss the implications for freshwater habitats and communities in Scotland.

WHITE-CLAWED CRAYFISH

The white clawed crayfish *Austropotamobius pallipes* (Lereboullet) is the only freshwater crayfish which is native to the British Isles and was formerly widespread in England, Wales and Ireland, but not in Scotland. It was also common in many parts of mainland Europe. Many of these populations have now disappeared, largely as a result of crayfish plague and, latterly, competition from alien crayfish. Crayfish plague, which is caused by the fungus *Aphanomyces astaci* Schikora, is thought to have been introduced into Italy in the 1860s from where it rapidly spread throughout Europe, devastating populations of native crayfish, both the white-clawed crayfish and the noble crayfish *Astacus astacus* (Linnaeus), which is native to mainland Europe but not to the British Isles.

Although the white-clawed crayfish is not believed to be native to Scotland, for several decades a population is known to have existed in limestone waters in the Durness area of Sutherland (Thomas, 1992). It is assumed that this population was introduced there early in the 20th Century. Because it is so far from other populations of crayfish this stock has never been affected by crayfish plague. Recent investigations at Durness have revealed that the white-clawed crayfish is still well established there (D. Mitchell, personal communication).

More recently, another population of white-clawed crayfish has been discovered by one of the authors (PSM) in a small reservoir in the catchment of the lower Clyde (Fig. 1a). According to local people it has been established there for at least 50 years and probably much longer. At the time of initial sampling (13th May, 2000) white-clawed crayfish of all sizes were common along the littoral zone (Fig. 2a) and the population is obviously thriving. As this species is protected in Great Britain (see below), specimens were returned to the water immediately after examination and photographing.

The white-clawed crayfish is listed as an endangered species by the World Conservation Union (IUCN) (Groombridge, 1993) and as globally threatened by Wynne *et al.* (1995). The British Isles now have the largest stocks of this species in Europe (Holdich & Rogers, 1995) where it was once widespread in France, Italy and Spain but is now confined to isolated sites in these countries. In the British Isles too its populations have been declining, mainly due to the impact of non-native crayfish and disease (Holdich & Rogers, 1995). The main threat to *A. pallipes* is crayfish plague which can be carried by the signal crayfish *Pacifastacus leniusculus* (Dana).

The white-clawed crayfish is now protected in Great Britain by its listing in Schedule 5 of the Wildlife and Countryside Act 1981 (which makes it illegal to take it from the wild and to sell it). It is also included in Appendix III of the Bern Convention (this lists protected species where, under certain conditions, some exploitation of their populations is permitted) and Annexes II (species whose conservation requires the designation of Special Areas of Conservation) and V (species whose taking in the wild may be subject to management measures) of the EC 'Habitats and Species' Directive (Boon *et al.*, 1992).

SIGNAL CRAYFISH

The signal crayfish *Pacifastacus leniusculus* (Dana) is an alien species, native to the western states of North America, which was first introduced to Sweden about 1960 and subsequently from there

Fig. 1a A live white-clawed crayfish from the new site located in the Clyde catchment.

Fig. 1b Five signal crayfish from the River Clyde showing the wide variation in size among the population there.

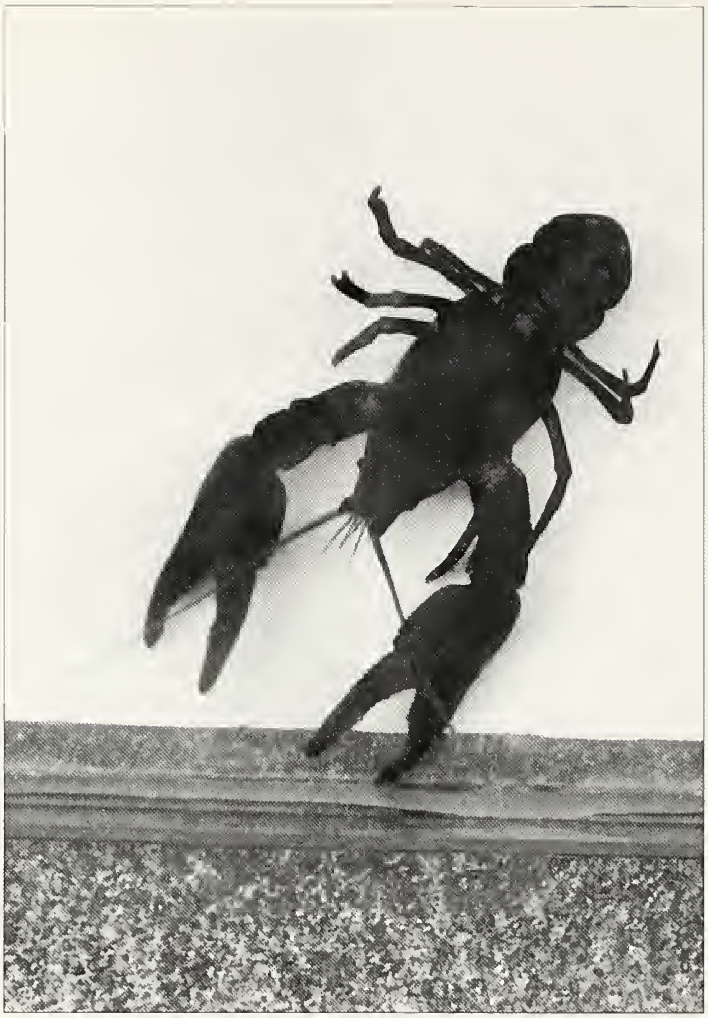


Fig. 1a

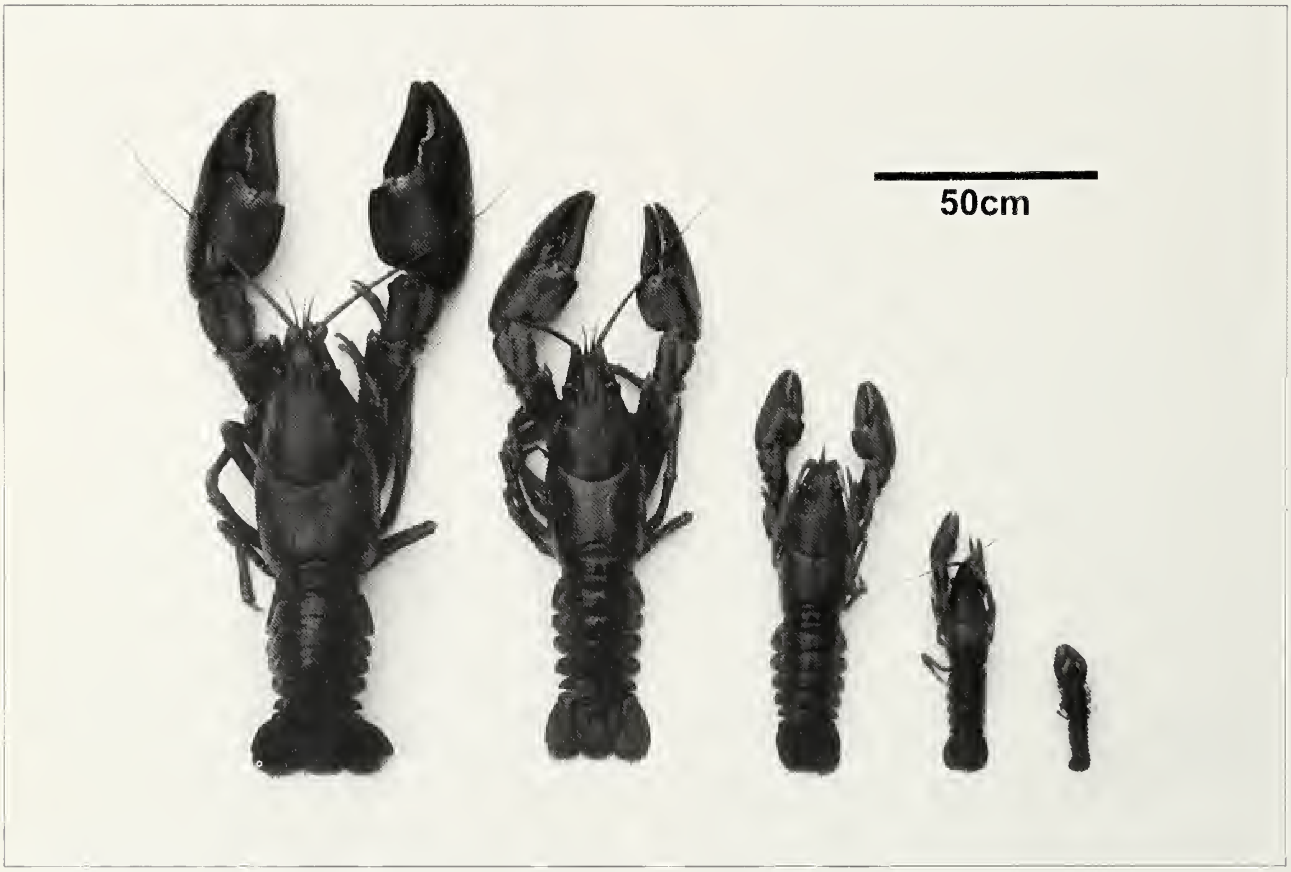


Fig. 1b

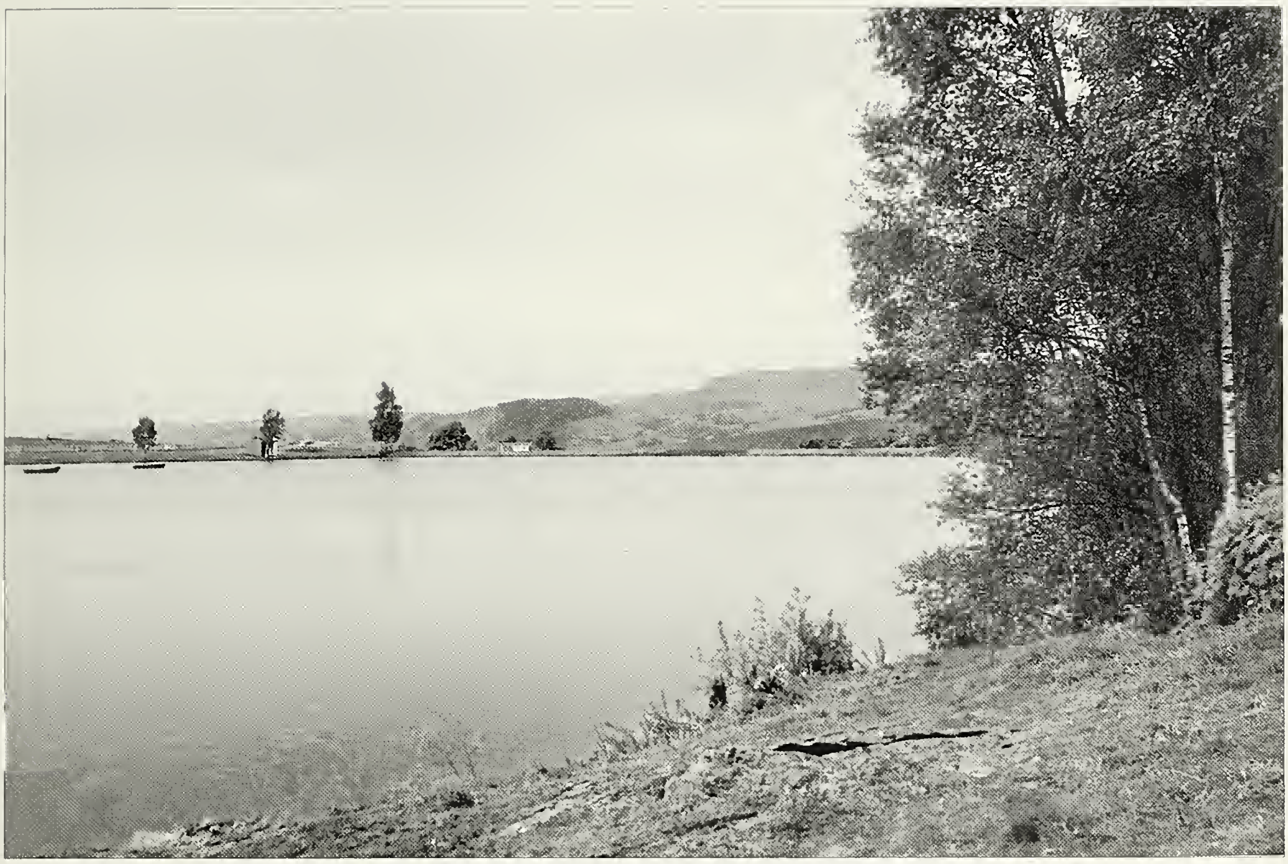


Fig. 2a The new site for white-clawed crayfish described in the text.

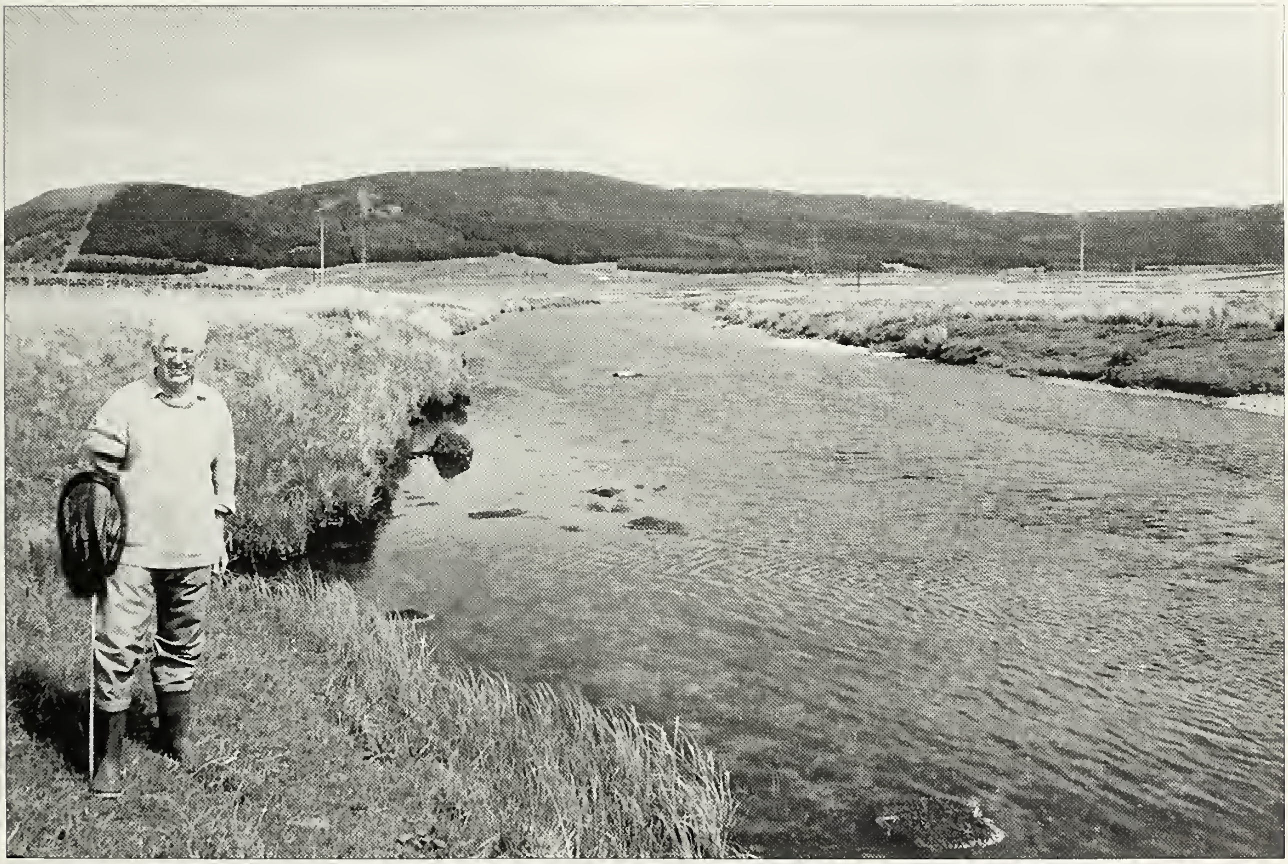


Fig. 2b The River Clyde at Elvanfoot where signal crayfish are now well established.

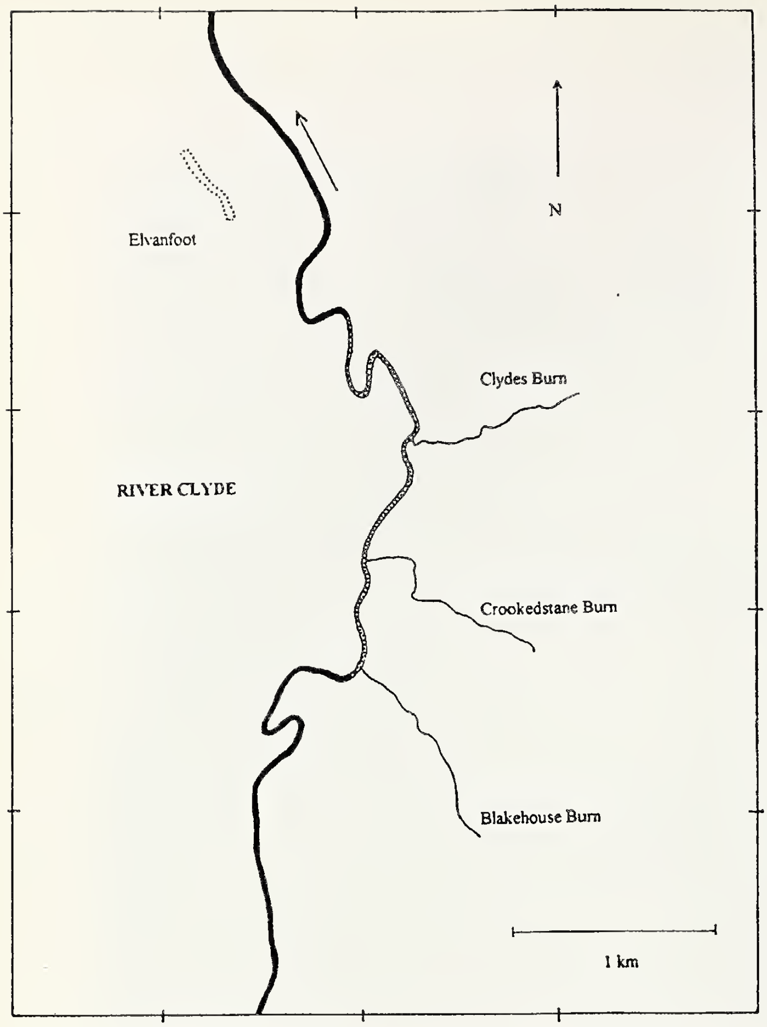
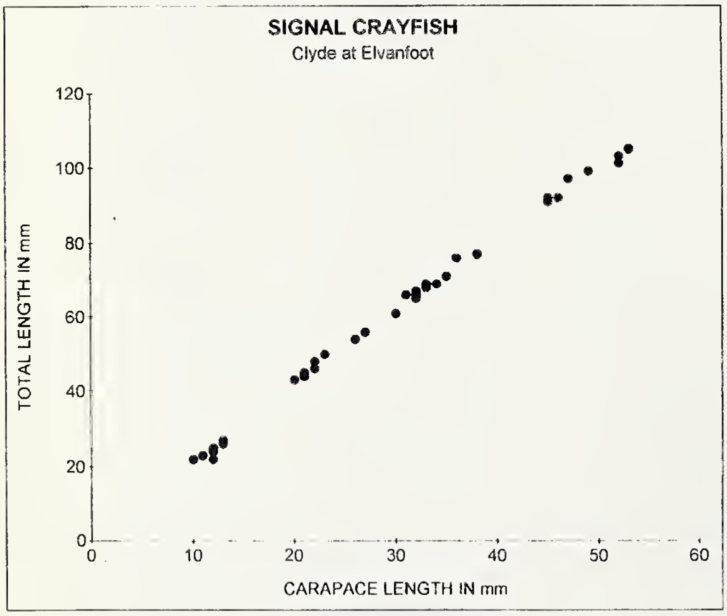
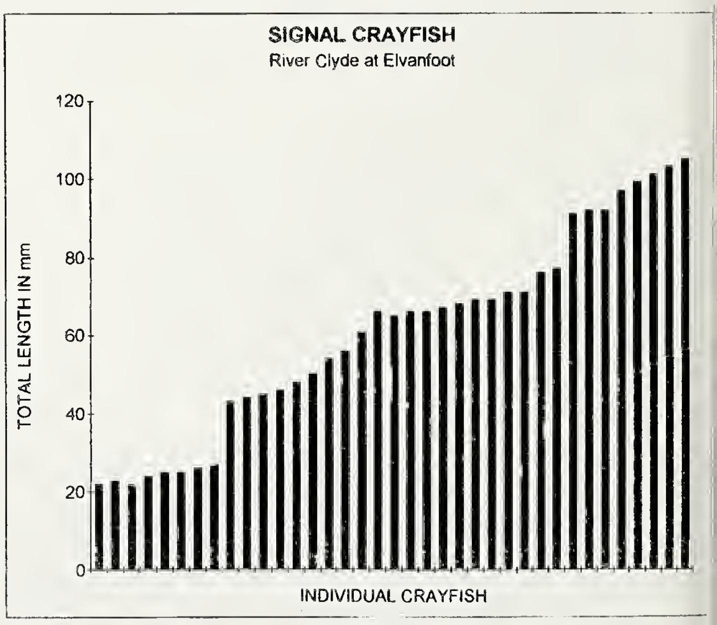


Fig. 3. (left) An outline map of the River Clyde in the Elvanfoot area, showing the distribution of signal crayfish in the year 2000 (stippling).

Fig. 4. (below, left) Relationship between total length and carapace length of signal crayfish from the River Clyde.

Fig. 5. (below, right) Total length distribution of a sample of signal crayfish taken from the River Clyde on 13th May, 2000.





into Great Britain in large numbers since the 1970s (Holdich & Reeve, 1991), mainly for crayfish farming. There are several records of this species having been brought into Scotland (again for crayfish farming) and some are known to have been released here. Localities into which signal crayfish are known to have been brought include Arran, Burntisland, Glasgow, Inverness, Jedburgh, Kirkcudbright, Lochgilphead, Oban, Rothesay and Tayside. Until recently, however, none of these stocks has been known to have become established in the wild. This compares with over 100 successful introductions to waters (both standing and running) in England and Wales, where the species is now well established in many catchments (Holdich & Rogers, 1992). As well as the farmed populations in open ponds, escapes from these crayfish farms in England have also led to many wild populations becoming established there.

The species was recorded recently as being well established at a stream site in southwest Scotland (Maitland, 1996) in the River Dee (Kirkcudbright) catchment where specimens were collected in the summer of 1995. Local information indicated that the species had occurred at this site for several years. Further populations were recorded in summer 1995 and summer 1998 (West Galloway Fisheries Trust, 1996 and 1999) at other sites in the system indicating a more widespread distribution than previously noted. Routine kick sampling by staff from the Scottish Environment Protection Agency (SEPA) further confirmed their presence in the Garple Burn and Water of Ken.

More recent investigations in the River Dee (Kirkcudbright) catchment have confirmed a more widespread distribution in the system (Sinclair & Ribbens, 2000) with stream sites and main river channel locations now utilised by the species. In total, a river length of at least 9.5 km is estimated to be populated by the species. It is also likely that Loch Ken itself is inhabited by crayfish due to the proximity of both stream and main channel crayfish records to this waterbody. It seems likely that further dispersal within the catchment is likely in future years.

In October 1999, the remains of an adult crayfish were found on gravel alongside the upper reaches of the River Clyde near Elvanfoot (Fig. 3) by William Miller, and confirmed by one of the authors (PSM) as a signal crayfish. Subsequently, searches in the river in the same area by William Miller revealed two live juvenile specimens of this species and several other dead specimens on the bank. An otter *Lutra lutra* was seen at the same time and may have been feeding on the crayfish. During a survey by Scottish Natural Heritage (SNH) and SEPA staff on 11th November, 1999, four juvenile signal crayfish were collected, just upstream of the Clydes Burn confluence. A few adult claws were also found on the river bank in the same area.

On 13th May, 2000, one of the authors and William Miller, using handnets, collected about 30 signal crayfish from the same stretch of river (Figs. 1b and 2b). These were photographed and measured for length. Both carapace and total lengths were measured, but subsequent analysis (Fig. 4) indicated that only one of these measurements is necessary as there is a close linear relationship between the two. The resulting length frequencies (Fig. 5) showed a wide range of size and indicated that at least five year classes were present in the population (Fig. 1b).

The discovery of signal crayfish in the River Clyde has caused great concern among local anglers for reasons which are discussed below, and early in 2000, the United Clyde Angling Protective Association funded a study to investigate means of control and the biology of this species in the area (Trudgill, 2000). This research has accumulated valuable information on the distribution, sex ratios, breeding cycle and numbers of crayfish in the study area and provides a valuable baseline for the future. Crayfish continue to be trapped in the River Clyde and it is estimated that a total of some 10,000 have been removed during the year 2000 (W. Miller, personal communication).

There have been unconfirmed reports of *Pacifastacus leniusculus* from other parts of Scotland. These require verification. However, two specimens of this species were found in 1995 at separate places in the River Earn (B. Clelland, personal communication) and it may well be establishing in other areas.

DISCUSSION

The introduction of crayfish to Scotland is not a new phenomenon. Some 150 years ago, Lord Breadalbane brought 1100 'crawfish' in spawn into Scotland, presumably for introduction to the River Tay (Anonymous, 1862). Crayfish were also put into waters in Lanarkshire, Dunbartonshire, Argyllshire and Renfrewshire around that time. It is possible that the present Clyde and Durness populations of white-clawed crayfish originated from stocks introduced during this period.

The origin of the Clyde population of signal crayfish is uncertain, but it is suspected that an attempt has been made to farm the species locally on a trial basis and the crayfish escaped or were deliberately dumped when the venture was curtailed. The use of crayfish as a bait by coarse fishermen visiting from the south has also been suggested as a possibility.

The release to the wild of signal crayfish is an offence under Section 14 of the Wildlife and Countryside Act 1981. In May 1996 MAFF and the Welsh Office introduced new licensing requirements for the keeping of non-native crayfish under the terms of the Prohibition of Keeping of Live Fish (Crayfish) Order 1996 and parallel legislation was introduced in Scotland. These Orders are intended to help protect native crayfish populations by preventing the spread of non-native species. They make the unlicensed keeping of non-native species an offence, with the exception of signal crayfish which may be kept without a licence in certain parts of England (but not Scotland), where extensive feral populations have become established.

Two main issues arise from the establishment of these crayfish in Scotland. Firstly, although the population of the white-clawed crayfish in Sutherland is almost certainly introduced, it has considerable conservation value since it provides a valuable safeguard stock in the event of serious problems further south. Durness is several hundred kilometres from the nearest populations in England and has, so far, not been subject to introductions of either alien crayfish species nor the crayfish plague which is often introduced with them (Holdich, 1988; 1991). The population of white-clawed crayfish in the lower Clyde area is much less safe, particularly now that signal crayfish are established in the upper Clyde.

Secondly, as far as the signal crayfish is concerned, it is clear that Scotland is no longer free from this aggressive and invasive species. It is known that the introduction on non-native crayfish can have profound effects on aquatic ecosystems, quite apart from the threat it poses to the native species (Palmer, 1994). Signal crayfish are large omnivores and can cause major changes in local flora and fauna through grazing and predation. They can also cause damage to river banks by burrowing, increasing erosion and having indirect effects on flora and fauna through habitat degradation. On a more positive note they do provide food for otters (crayfish remains have been found in otter spraints on the Clyde) and some fish - though it must be remembered that such crayfish (usually small ones) have already eaten what would be the normal invertebrate food of these fish.

The statutory nature conservation agencies recommended that 'if and when suitable control measures are developed, eradication of non-native crayfish populations should be attempted by the appropriate authority or individual, where the introduced species threatens particularly sensitive sites' (Palmer, 1994). Crucial to the effective deployment of a control strategy for additional crayfish populations identified in Scotland is the early notification of the presence of the species. Such reporting is encouraged in England and Wales by the Environment Agency (EA) (Holdich & Rogers, 1999) where a national database and regional recording structure is present. At the moment there is no such system promoted in Scotland but it is hoped that a media campaign to raise awareness of the issue will be promoted by SNH and SEPA.

Although this eradication of crayfish populations is an ideal, and something which may be possible if small populations are detected early enough (Maitland, 1996) it is obviously a difficult task when stocks are fully established. Crayfish removal studies completed using electrofishing techniques in the River Dee (Kirkcudbright) catchment have indicated that this method is capable of removing large numbers of specimens of all age and length classes but that total eradication is not achievable when an established population is encountered (Sinclair & Ribbens, 2000). Other strategies such as mechanical removal via trapping and biological, physical and chemical control techniques are unlikely to be appropriate or effective in many situations due to environmental, resource and technological constraints. However, the EA is currently funding a research project on the eradication of alien crayfish populations, mostly involving mechanical methods, though at least one trial using biological control (stocking with eels *Anguilla anguilla* and chub *Leuciscus cephalus*) is proposed. The easier solution is to try to prevent alien animals ever reaching Scotland in the first place, through both legislation and education.

The stream and main channel sites known to contain crayfish in Galloway lie within the catchment of the Water of Ken above Loch Ken. It is likely that the species is now present in the larger waters of the loch and the River Dee downstream. Both of these systems offer apparently suitable habitats for the species and it seems likely that there may be further extensions to existing populations in future years. Although the rate of spread in the River Dee is presently unquantified the species is invasive and has been found to spread in rivers at a rate of approximately 1 km/year (Holdich *et al.*, 1995).

Further spread of the population in the upper Clyde area is also likely as dispersal through much of this large catchment would appear to be straightforward. Routine biological sampling by SEPA at a site above Elvanfoot Bridge has never detected crayfish in the past, but it seems likely that signal crayfish will be recorded here before too long. The present limits of distribution appear to be from the confluence of the Blakehouse Burn downstream to about one kilometre below Clydes Burn, with some dispersion into the lower reaches of these burns and the Crookedstane Burn (Fig. 3).

Futher research on, and monitoring of, all these populations - both white-clawed and signal crayfish - is of some immediate importance in order (a) to determine stock size and observe any geographic dispersal, (b) to analyse their ecological performance in comparison with that of populations further south, and (c) to assess the nature and status of the native populations of plants, invertebrates and fish in the waters concerned. Such studies will provide essential baseline information from which to assess the rate of spread and impact on local habitats, especially where signal crayfish are established, for this species has the reputation of being both invasive and aggressive. It is known that population growth can be rapid under suitable conditions and that this crayfish can soon become the dominant invertebrate (Holdich & Reeve, 1991). Eradication measures of some kind are probably too late now and it seems likely that signal crayfish may become as successful an invader in the Galloway and Clyde systems as has the ruffe *Gymnocephalus cernuus* in Loch Lomond (Maitland *et al.*, 1983) over the last decade.

It is to be hoped that further irresponsible introductions to Scotland can be prevented in the future (Maitland, 1987). In England, not only is the signal crayfish well established in numerous waters, but the noble crayfish - an alien species native to parts of continental Europe - is now established at one location in the Mendips (Holdich & Rogers, 1999).

ACKNOWLEDGEMENTS

The Clyde population of signal crayfish was first discovered by William Miller, whom we thank for his help and advice. We are grateful also to Brian Clelland, William Duncan and Donald Mitchell for information regarding the current status of some of the populations discussed in this paper. Helpful comments on an earlier draft were received from Dr Roger Downie and an unknown referee.

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LIMAX FLAVUS - A VERSATILE SLUG

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Slugs get a bad press. I wasn't keen on them myself until my interest was aroused by the felling of an old elm tree in 1991. The massive tree stood in the earth border of this modern block of Glasgow flats, about a metre from the edge of the tarmac car park. Its top had been pollarded some decades ago and heavy branches rose from the lopped zone. For some years it had been dying back and Dutch elm disease was diagnosed, its felling decreed.

I counted 128 tree rings on the stump, the last 20 of them small, narrow and crowded on the side nearest the car park. There was no evidence of Dutch elm disease and it appeared that the elm had suffered dehydration from the laying of the tarmac around the flats, built 20 years before, thus waterproofing much of the ground below which its roots extended on the side with narrowed rings.

The cut timber revealed heart rot below the level of pollarding. This was full of soft wood-dust seething with large slugs and red "brandling" worms. Many slugs may have already wandered off, but I counted over 30 specimens, small and large up to over 8 cm in length, identified as *Limax flavus*. It can grow to over 10cm in length, mottled with a yellowish mantle and bluish "tentacles". This consumer of decaying vegetable matter, rotten wood, fungi, lichens and algae is a useful scavenger, not a gardener's enemy.

Limax flavus was not previously recorded for Glasgow in the *Recorder database* of the Biological Records Centre (Richard Weddle, personal communication) but Dr. Adrian Sumner informs me that the Molluscan Atlas contains a few records for the Glasgow area.

I then became aware of slime trails from slugs on the trunk and branches of various trees in this area, and grazing trails on woodwork, stone, metal and cement areas where slugs had scraped away algae from the surfaces (Fig. 1). On fine mornings after mild, humid nights, trails gave evidence of nocturnal wanderings of large slugs. These were not necessarily all *L.flavus*, for we also have an occasional *Limax maximus*, another scavenger, which can reach 20cm long, but few of the small greyish slug species which munch vegetation. On a mild humid night after dark I have seen up to six slugs, all *L.flavus*, starting their night's foraging from their daytime retreats in crevices of the brickwork of a row of garages near the old elm stump. Slime trails here and in the local area often lead to nutritious debris - remnants of spilled ice cream on pavements, squashed worms or slugs, and various dejecta including some droppings of birds, foxes etc. We rarely see snails, as there is too little calcium here for their shells.

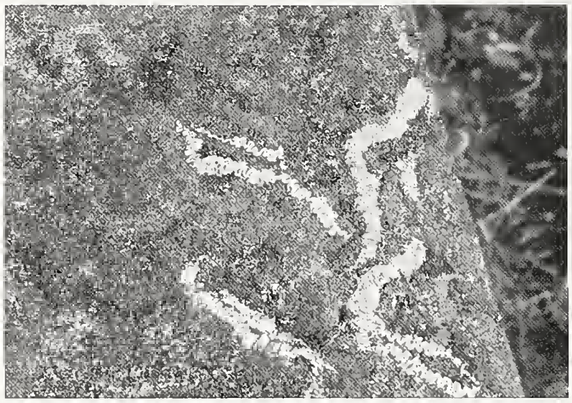

Fig. 1 Slug grazing trails on metal coping: algae removed and metal exposed by scrapes of toothed radula as slug swings head from side to side.

Recently we became aware of an increasing network of slime trails from a crevice, entering under the door of our garage and spreading below the bench where we keep bird food. Occasional spills of bird seeds and trampled peanuts were evident targets of attraction. The trails extend up the wall at the end of the bench, where I sometimes noticed early deterioration and even perforation of paper bags in which we store crushed peanuts for the smaller birds. We have never had evidence of mice at these premises, but one day I noticed holes in a bag forming an irregular track about 30 x 3 mm, with slight shiny traces of slime. Slug(s) had perforated the paper (vegetable matter), tastily soaked in peanut oil, to gain access to the nuts. Closer scrutiny showed intermittent evidence of widespread wanderings on the bench. The upper surface of the top biscuit in an opened packet had been attacked, with slight shiny residues from the slug on top and also, less obviously, on the shiny outside of the packet which it had climbed. I was already aware that slugs cleaned up remnants of biscuits crushed for blackbirds on the corner posts of our composter. Slime trails often led across a hardboard sheet on which occasional crumbs of cake had been scattered the previous day - within 24 hrs, suggesting that slugs can scent food from a distance (osmoreceptors are near the eyes in the pigmented upper tentacles). One evening we found a fine specimen of *L. flavus* ascending a plastic watering can below the bench. I released it on the trunk of a nearby tree; next morning its trail led upwards high into the tree. I washed off the water-soluble entry slime trails below the garage door, but next morning fresh trails showed that our intruder was by no means alone. At 0845hrs on Dec.14 I noticed another one at about 12cm full stretch, homebound round the doorpost after its nocturnal raid and about to enter the crevice; I scooped it up and liberated it on the same tree where it soon disappeared. A week later about the same time a third one was accidentally squashed underfoot on its return trip, and proliferation of fresh trails shows that there must be a colony in the crevice. Our watch continues. I now understand that *L. flavus* is a well known pest of stored foods in cellars and granaries (Runham & Hunter,1970).

We noted that plastic bags of bird seed were not perforated. Presumably the slug's rasping radula (its feeding organ) skids off the shiny plastic surface without penetrating, so paper bags of crushed nuts were protected by putting them inside these flimsy plastic bags. Even then a slug can sometimes get into the bag, climb up the shiny packet, graze the biscuit and retrace its tracks to escape before morning.

I am left admiring the skill and industry of these mainly nocturnal scavengers. They help to clear up our environment, homing in to tasty morsels which they evidently sense from several feet away. They are not particularly slimy to touch as the textured back feels relatively dry. Slime is mainly produced by a gland below the "foot" when and where required to obtain traction on a surface - even across spider webs! This trail is not always continuous but usually forms an interrupted line of "dashes", each of perhaps a couple of centimetres with gaps of a centimetre or so, not to waste this precious material. The microcrystals in the trail indicate the direction of travel, recognisable by the same slug for future journeys and by other slugs. There has even been interest in the possibility of utilising such crystals for future computers - apparently faster than current microchips. Is there no end to the versatility of these ingenious molluscs?

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NEW RECORDS OF AMPHIPODS AND LEPTOSTRACANS FROM THE FORTH SEA AREA, WITH NOTES ON THEIR COPEPOD PARASITES (SIPHONOSTOMATOIDA: NICOTHOIDAE)

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INTRODUCTION

In 1986 the Forth River Purification Board (FRPB) commenced monitoring of Lothian Region Council sewage disposal grounds, 17.5km north of St. Abbs Head and 13.5km east of Bell Rock, in the Forth Sea area. Part of the programme included establishing a reference collection of benthic invertebrates as an aid to gauging impact on the biodiversity of benthic fauna. Between 1986 and 1989 a variety of crustaceans were recovered which included species of amphipods and leptostracans new to the Forth Sea area. In view of the current interest in biodiversity, details of the newly recorded species are now provided, along with notes on other species present from the same families and any observed incidences of parasitism by copepods.

AMPHIPODS

The Order Amphipoda comprises small crustaceans such as the familiar shore "shrimps" (*Gammarus spp.*) and beach "sandhoppers" (*Talitrus spp.*) but includes many additional species within the marine realm. There are four sub-orders; Gammaridea, Caprellidea, Hyperiidea, and Ingolfiellidea. The Caprellidea (skeleton shrimps) contains twelve British species which generally lead an epifaunal existence clambering over rocks, stones and hydroids, although they do also turn up in sediment grab samples. *Caprella linearis* (Linnaeus, 1767), *Pariambus typicus* (Kroyer, 1844), and *Phtisica marina* Slabber, 1769, were regularly recovered at both disposal grounds while *Pseudoprotella phasma* (Montagu, 1804) also occurred at Bell Rock. An identification key to British caprellids is provide by Harrison (1944). The only other caprellid species ever identified in FRPB surveys is *Caprella tuberculata* Bate & Westwood, 1868, of which a single female was collected at Hound Point in 1996. The Hyperiidea contains around 50 British species all of which are planktonic. Although these would not be expected in benthic samples, a number of *Parathemisto gaudichaudi* (Guerin-Meneville, 1825) were recovered at St. Abbs - presumably derived from sea-water hoses used to sieve the sediment samples. The Cyamidea (whale lice) are all ectoparasites of cetaceans. Some recent Forth Sea area records from stranded whales are provided by O'Reilly (1998). The Ingolfiellidea is represented by a single British species which burrows in coarse sediments and is restricted to the English Channel.

The Gammaridea is the largest amphipod sub-order and contains over 270 British species most of which occur in marine waters. The British Gammarideans were studied in detail in a monograph by Lincoln (1979) which has become the standard work for their identification. The amphipods from the Clyde Sea area were reviewed by Moore (1984a). Only gammaridean amphipods are discussed further here. A total of 38 gammaridean amphipods new to the Forth Sea area were recorded at the disposal grounds and included both common species and rare ones. Other benthic faunal studies (Parker, 1984; Dewarumez, *et al.*1992) have also revealed amphipods new to their respective areas indicating that much remains to be learned regarding local inventories of biodiversity. The amphipods new to the Forth Sea area include the first British record of *Paradulichia typica* Boeck, 1870, and in addition two rare species; *Metopa robusta* Sars, 1892, which had been recorded from the Forth by Scott (1906) but seems to have been overlooked by Lincoln (1979), and *Acanthonotozoma serratum* (Fabricius, 1780) first recorded in the UK from St.Abbs, by Moore (1984b).

LEPTOSTRACANS AND NICOTHOID COPEPODS

The Order Leptostraca comprises small marine crustaceans superficially similar in appearance to brine shrimps. Four species are cited from "British" waters by Mauchline (1984) but only one of these is known from waters less than 200m deep. The taxonomy of leptostracans from the European shelf was revised by Dahl (1985) with the recognition of additional British species.

The Nicotoidae is a family of minute copepods which parasitise other crustaceans including amphipods (Gotto, 1993) and also leptostracans (Gotto, 1984). A number of amphipods from British waters are infested by *Sphaeronella* species which inhabit the brood pouch of females. They are generally overlooked on account of their small size and published records are few and far between (Green, 1958; Gotto & McGrath, 1980; Moore, 1984a; Moore &

Wong, 1996; O'Reilly & Geddes, 2000). The records of these parasites in the amphipods *Ampelisca tenuicornis* Lilljeborg, 1855, *Amphilochus neapolitanus* Della Valle, 1893, *Perioculodes longimanus* (Bate & Westwood, 1868) and *Corophium crassicorne* Bruzelius, 1859, from the Forth Sea area were briefly cited in Costello & Myers (1989) and included in Gotto (1993) under "south-east Scotland" but further details are provided here along with an additional record from *Bathyporeia pelagica* (Bate, 1856).

SAMPLING

The benthic surveys were carried out at St. Abbs in June 1986, '87, '88, & '89 and at Bell Rock in Jan. & Nov.'87, and April & Oct.'89. At St. Abbs the same eleven stations were sampled each year and at Bell Rock the same nine stations (Fig. 1). The grabbing stations lie within a radius of 2 nautical miles of the disposal ground centres (St.Abbs Stn.13 - 56°04.50'N, 02°07.27'W, and Bell Rock Stn.13 - 56°25.00'N, 02°10.00'W). Trawls were carried out at both stn.13's and a single control station, "C", just outside the Bell Rock disposal area. The depths at both disposal grounds varied between 50 - 60m. At each grabbing station 2 van Veen grabs ($0.1m^2$) of sediment were collected and sieved on 0.5mm mesh. All material was fixed on site with formalin prior to identification in the laboratory.

NOTES ON NEW AMPHIPODS AND LEPTOSTRACANS AND PARASITIC COPEPODS

The order below follows Lincoln (1979), though the nomenclature has been updated to that in Howson & Picton (1997). For brevity the full authorities and dates are only provided for the species new to the area. Only families which include species new to the Forth Sea area are discussed. Notes on the new species include for each survey the total number of specimens observed, along with the station numbers if recorded at four or fewer stations, or, if found at more than four stations, the total number of specimens and the number of stations at which they were observed.

Order: AMPHIPODA
Sub-order: GAMMARIDEA
Family **Lysianassidae**

Acidostoma obesum (Bate & Westwood, 1861)

Bell Rock, Jan.'87 - 2 at stns. 11,13, Nov.'87 - 3 at stns.11,17,23.

Euonyx chelatus Norman, 1867

Bell Rock, Jan.'87 - 2 trawled at stn.13 & stn.C.

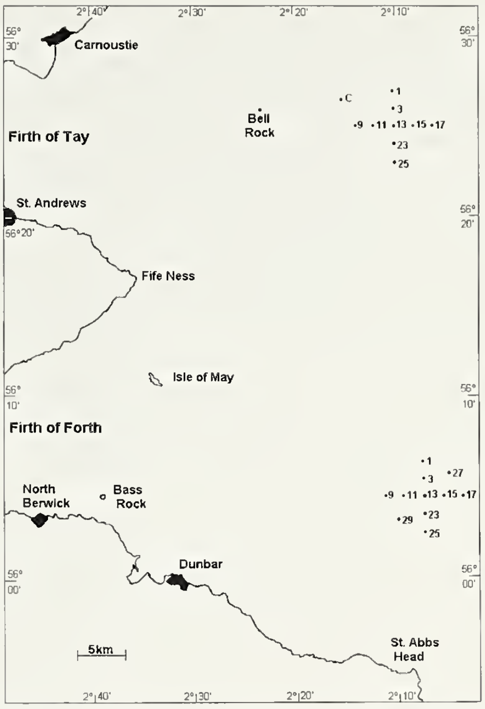

Figure 1: Location of disposal ground sampling stations at St.Abbs, and Bell Rock.

A family of robust amphipods, many of which have a peculiar hirsute gnathopod 2 superficially resembling a "cat's paw". *Acidostoma nodiferum* (=*A..sarsi* in Lincoln), *Hippomedon denticulatus,*and *Tryphosites longipes* also occurred at St. Abbs, while at Bell Rock *A. nodiferum, H. denticulatus, Lepidopecreum longicorne, Orchomene nanus,* and *Scopelocheiros hopei* were observed.

Family **Ampeliscidae**

Ampelisca diadema (Costa, 1853)

St. Abbs - Jun.'86 -1 at stn.17, Jun.'87 - 3 at stn.13, Bell Rock Jan.'87 - 4 at stn.13, Nov.'87 - 2 at stn.23.

Ampelisca tenuicornis Lilljeborg, 1855

St. Abbs - Jun.'86 - 197 at all 11 stns., Jun. '87 - 243 at all 11stns., Jun.'88 - 232 at all 11 stns., Jun.'89 - 277 at all 11 stns., Bell Rock - Jan.'87 - 130 at all 9 stns., Nov.'87 - 86 at all 9 stns., Apr.'89 - 18 at 6 stns., Oct.'89 - 176 at all 9 stns.

Ampelisca typica (Bate, 1856)

Bell Rock, Jan.'87 - 3 at stns.3,9,13.

The genus *Ampelisca* was reviewed by Dauvin & Bellan-Santini (1988). These are generally large amphipods, strongly laterally compressed, with distinct cuticular lens eyes. *A. brevicornis* and *A. macrocephala* were both common at St. Abbs and Bell Rock but *A. tenuicornis* was by far the most abundant and was usually found at all the stations. Nine of the *A.*

tenuicornis from St. Abbs (5 in '86, 2 in '87, 2 in '88) were found to be harbouring the copepod, *Sphaeronella longipes* Hansen, 1897, in their brood pouch. In each case a single juvenile female was observed. Two *A. brevicornis* from Bell Rock (stn.9, Jan.'87 and stn.9 Apr.'89) were hosts to immature "pupal stages" of *Sphaeronella* copepods.

Family **Acanthonotozomatidae**

Acanthonotozoma serratum (Fabricius, 1780) [see Figure 2a]

Bell Rock - Jan.'87 - 1 female (6mm long) trawled at stn.13. The specimen is deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.1)

The only British record of this arctic species comprised two specimens collected by a diver at Coldringham Bay, near St. Abbs (Moore 1984a). In view of its rarity the new record is mentioned here. The genus was reviewed by Just (1978) who also included notes and figures of copepod parasites.

Family **Amphilochidae**

Amphilochus neapolitanus Della Valle, 1893

St. Abbs Jun.'87 - 2 at stns.3,13, Jun.'88 - 1 at stn.1, Jun.'89 - 3 at stns.9,27, Bell Rock Jan.'87 - 6 at stns.9,15,17,25, Nov.'87 - 8 at stns.3,9,11,13.

This is regarded as a Mediterranean species at the northern limit of its distribution. Parker (1984) claimed the most northerly British record from Belfast Lough. However, Sheader (1983) cited a single specimen collected from Blyth on the Northumberland coast in 1952. Although Sheader considered this record questionable the present finds from the Forth Sea area suggest *A. neapolitanus* may be widespread in the North Sea. In fact, it has since been found even further north in the Gullmarfjord in western Sweden (Buhl-Jensen & Fossa, 1991).

One of the amphipods collected at Bell Rock, stn.11, Nov.'87 contained a mature female and 2 male copepods in its brood pouch, tentatively identified as *Sphaeronella amphilochii* Hansen, 1897.

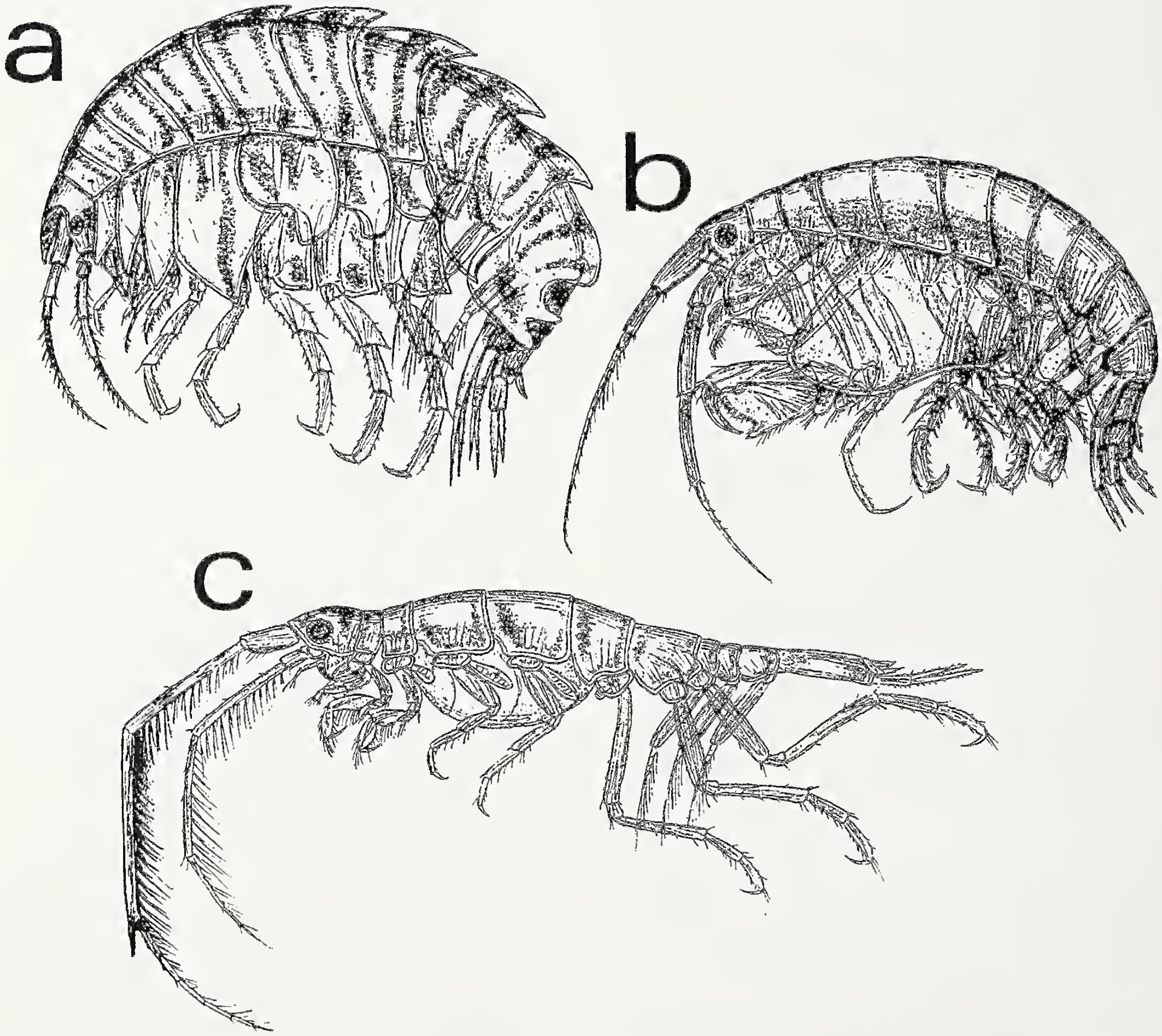

Figure 2: a) ***Acanthonotozoma serratum*****, length up to 12mm. b)** ***Metopa robusta*****, length up to 6mm. c)** ***Paradulichia typica*****, length up to 5mm. (All after Sars, 1890-95)**

Amphilochids are small amphipods and identification requires careful examination of the gnathopods. *Gitana sarsi, Paramphilochoides odontonyx* and *Amphilochus manudens* were recorded at both St. Abbs and Bell Rock.

Family **Stenothoidae**

Metopa latimana Hansen, 1887

St. Abbs Jun.'88 - 3 at stns. 1,17,27, Jun.'89 - 1 at stn.15, Bell Rock Jan.'87 - 1 at stn.1, Oct.'89 - 2 at stn.1.

Metopa tenuimana Sars, 1892

Bell Rock Jan.'87 - 2 at stn.3

Metopa robusta Sars, 1892 [see Figure 2b]

St. Abbs Jun.'89 - 6 at stn.17, Bell Rock Nov.'87 - 4 at stns.1,9,13. The 3 adult females, and 3 juvs., from stn.17 have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.2-7). Material has also been deposited in the British Museum (Natural History), London.

The key features of *M. robusta* include the gnathopod structure, telson armature and sinuous ventral border of coxal plate 4. It was in fact recorded from the Forth by Scott (1906) but was not included in Lincoln's monograph. It was also recorded off the Northumberland coast by Sheader (1983).

Stenothoids are also rather small amphipods but with conspicuous large coxal plates. The gnathopods and armature of the telson are important aids for identification. *Metopa bruzelii, M. pusilla* and *Stenula rubrovitatta* were recorded at St.Abbs and additionally *M. norvegica* and *Stenothoe marina* were found at Bell Rock.

Family **Melitidae**

Cheirocratus assimilis (Lilljeborg, 1852)

Bell Rock Jan.'87 - 9 at stn.1, Nov.'87 - 2 at stn.1, 3, Oct.'89 - 1 at stn.3.

Cheirocratus intermedius G.O.Sars, 1894

St. Abbs Jun.'87 - 1 at stn.23.

Melita dentata (Kroyer,1842)

St. Abbs Jun.'87 - 1 at stn.27, Jun.'88 - 2 at stn.15.

Melita hergensis Reid,1939

St. Abbs Jun.'87 - 1 at stn.3, Bell Rock Jan.'87 - 5 at stn.15.

Melitids are large amphipods usually with elongated uropod 3 and, in males, enlarged gnathopod 2, the latter being diagnostic for each species. The genus *Cheirocratus* exhibits a relatively unusual feature with the first antennae being shorter than the second. *Maera loveni, M. othonis*, and *Abludomelita obtusata* (*Melita obtusata* in Lincoln, 1979), were recovered from St. Abbs and *Cheirocratus sundevallii* was also found at Bell Rock.

Family **Pontoporeiidae**

Bathyporeia elegans Watkin, 1938

Bell Rock Jan.'87 - 23 at 7 stns., Nov.'87 - 50 at 7 stns., Apr.'89 - 19 at 7 stns., Oct.'89 - 9 at 5 stns.

The genus *Bathyporeia* contains a number of species which are abundant in intertidal and sublittoral sandy sediments They all have a distinctive geniculate first antennae. The species can be quite difficult to distinguish and although several species were tentatively identified from the disposal grounds only the record of *B. elegans* was confirmed by P.G. Moore. However additional *Bathyporeia* species have been identified in the Clyde Sea area (Barclay, 1982) and it is likely that further species may also exist in the Forth Sea area. None of the *B. elegans* from the disposal grounds were parasitised by copepods. However a single female of *B. pelagica* collected intertidally from Belhaven Bay, Dunbar in June '88 was infested by a large mature female of *Sphaeronella paradoxa* Hansen, 1897. While the copepod exhibited the typical angular ventrum of this species, the diagnostic umbilical attachment filament was absent.

Family **Urothoidae**

Urothoe elegans (Bate, 1856)

St. Abbs Jun.'87 - 2 at stn.17, Jun.'88 - 1 at stn.27, Jun.'89 - 8 at stn.1,17, Bell Rock Jan.'87 - 78 at 7 stns., Nov.'87 - 63 at 7 stns., Apr.'89 - 91 at 5 stns., Oct.'89 - 70 at 6 stns.

Family **Oedicerotidae**

Pontocrates arenarius (Bate, 1858)

St. Abbs Jun.'87 -1 at stn.27, Jun.'89 - 1 at stn.27, Bell Rock Apr.'89 - 1 at stn.3, Oct.'89 - 8 at 5 stns.

Synchelidium maculatum Stebbing, 1906

St. Abbs Jun.'87 - 1 at stn.3, Bell Rock Jan.'87 - 4 at stn.11,13,23, Apr.'89 - 2 at stns.1,11.

Oedicerotids are characterised by their helmet-shaped heads. Five species have previously been recorded from the Forth Sea area of which two, *Perioculodes longimanus* and *Westwoodilla caecula* were common at St. Abbs and Bell Rock. An additional species, *Pontocrates arcticus* Sars, 1893 has only recently been recognised from British waters from the Firth of Clyde (Moore & Beare, 1993) and may well also occur in the Forth Sea area. *Perioculodes longimanus* was a particularly abundant species at the disposal grounds and was frequently parasitised by the copepod *Sphaeronella minuta* Scott, 1904. Eight amphipods from St.Abbs were infested (1 in '86, 3 in '87, 2 in '88, 2 in '89), mostly with juvenile parasites but also one mature, and two ovigerous, females. More infested amphipods were observed at Bell Rock (24 in Jan.'87, 1 in Apr.'89). Again most of the copepods appeared to be juveniles but included two ovigerous females. A single mature female copepod was also recovered from a *P. longimanus* collected at Dunbar in 1988. Scott (1904) figured this species with a short umbilical attachment thread similar to that of *S. paradoxa* (which parasitises *Bathyporeia spp.*). However, none of the Forth specimens appeared to have such a thread.

Family **Melphidippidae**

Megaluropus agilis (Hoek, 1889)

Bell Rock Nov.'87 - 1 at stn.11, Apr.'89 - 1 at stn.3.

Family **Calliopiidae**

Apherusa bispinosa (Bate, 1856)

St. Abbs Jun.'88 - 3 at stns. 1, 27.

Family **Pleustidae**

Parapleustes bicuspis (Kroyer, 1838)

St. Abbs Jun.'87 - 1 at stn.17, Bell Rock Jan.'87 - 1 at stn.1.

Stenopleustes latipes (G.O.Sars, 1858)

St. Abbs Jun.'86 - 14 at stn.17, Bell Rock Jan.'87 - 3 at stn.13, Nov.'87 - 2 at stn.13.

Stenopleustes nodifer (G.O.Sars, 1882)

St. Abbs Jun.'86 - 1 at stn.17.

A small family with only 5 British species. Only *Parapleustes assimilis* is previously recorded from the Forth Sea area, and was also found at St. Abbs.

Family **Paramphithoidae**

Epimeria cornigera (Fabricius, 1779)

St. Abbs Jun.'86 -10 at stn.13. None of these were recovered from grab samples but were found among debris in a fish trawl undertaken at the centre of the disposal ground as an additional part of the monitoring programme.

Family **Dexaminidae**

Guernea coalita (Norman, 1868)

Bell Rock Apr.'89 - 1 at stn.3. A small species, easily overlooked. In addition to plumose setae on leg 7, the urosome has a knobbly appearance dorsally.

Family **Aoridae**

Aora gracilis (Bate, 1857) [Lincoln, 1979 as *A. typica* Kroyer, 1845]

St. Abbs Jun.'87 - 1 at stn.15, Bell Rock Nov.'87 - 32 at stn.13, Apr.'89 - 1 at stn.23.

Autonoe longipes (Lilljeborg, 1852) [Lincoln, 1979 as *Lembos longipes*]

St. Abbs Jun.'86 - 19 at 7 stns., Jun.'87 - 33 at 6 stns., Jun.'89 - 10 at 6 stns., Bell Rock Jan.'87 - 96 at 8 stns., Nov.'87 - 63 at all 9 stns., Apr.'89 - 4 at stn.23, Oct.'89 - 80 at 8 stns.

Leptocheiros hirsutimanus (Bate, 1862)

Bell Rock Jan.'87 - 7 at stns. 1, 3, Nov.'87 - 15 at stn.3, Apr.'89 - 3 at stn.3, Oct.'89 - 7 at stns.1, 3.

Females of this family are often difficult to distinguish, even at generic level. Mature males however have sexually dimorphic gnathopods which are generally diagnostic. The genus *Aora* in British waters was reviewed by Myers & Costello (1984). *Aora typica* is a southern ocean species and does not occur in Britain. Records of *A. typica* from British waters probably refer, for the most part, to *A. gracilis*. However a new species *A. spinicornis* was described by Myers & Costello (1984) from south west Ireland and may be present in other localities.

Family **Isaeidae**

Gammaropsis maculata (Johnston, 1828)

St. Abbs Jun.'87 - 3 at st.13,15, Jun.'88 - 49 at 9 stns., Jun.'89 - 10 at 5 stns., Bell Rock Nov.'87 -30 at stns.1,3,9,13, Apr.'89 - 8 at 5 stns., Oct.'89 - 3 at stns.17,25.

Gammaropsis palmata (Stebbing & Robertson, 1891)

St. Abbs Jun.'86 - 29 at 9 stns., Jun.'87 - 25 at

8 stns., Jun.'88 - 37 at all 11 stns., Jun.'89 - 20 at 7 stns., Bell Rock Nov.'87 - 39 at 6 stns., Apr.'89 - 6 at stns.1,25, Oct.'89 - 8 at stns.3,13.

Gammaropsis nitida (Stimpson, 1853)

St. Abbs Jun.'87 - 21 at stn.15, Bell Rock Apr.'89 - 1 at stn.9.

Gammaropsis cornuta (Norman, 1869) [Lincoln, 1979, as *Megamphopus cornutus*]

St. Abbs Jun.'88 - 2 at stn.25, Bell Rock Nov.'87 - 1 female, Apr.'89 - 2 at stn.1.

Photis longicaudata (Bate & Westwood, 1862)

St. Abbs Jun.'87 - 13 at stn.17, Jun.'88 - 9 at stns.11,17,29, Jun.'89 - 1 at stn.25, Bell Rock Jan.'87 - 37 at stn.1,3,13,15, Nov.'87 - 46 at stns.1,13,23,25, Oct.'89 - 1 at stn.13.

Photis reinhardi Kroyer, 1842

Bell Rock Jan.'87 - 2 at stn.1. Confirmed by P.G. Moore on basis of female Gnathopod 1.

Although only two Isaeid species are previously recorded from the Forth Sea area, seven species were identified at the disposal grounds of which, only *Protomedeia fasciata*, was already known. The genus *Gammaropsis* is readily reeognised by the acute eye lobes. In *Photis longicaudata* the inner ramus of uropod 3 is so small that that the uropods appear to be uniramous. Morover the uropod 3 rami in this species are frequently upturned. The genera *Photis* and *Gammaropsis* in British waters are reviewed by Myers & McGrath (1981, 1982).

Family **Corophiidae**

Corophium crassicorne Bruzelius, 1859

Bell Rock Jan.'87 - 18 at 5 stns., Nov.'87 - 13 at 6 stns.,Oct.'89 - 10 at 5 stns.

Three of the amphipods collected in Jan.'87 (stns.3,9,25) harboured single copepods in their brood pouch, identified as juvenile female *Sphaeronella danica* Hansen, 1897.

Siphonoecetes striatus Myers & McGrath, 1979

Bell Rock Nov.'87 - 9 at 5 stns, Apr.'89 - 1 at stn.1. This species is difficult to distinguish from *S. kroyeranus*. Ideally mature specimens are required which retain their pigmentation patterns on the rostrum and antennae (see Myers & McGrath, 1979). In view of the apparent occurrence of *S. striatus* from the area, previous records of *S. kroyeranus* may be mistaken and the presence of both species in the Forth now requires confirmation.

Corophiids are one of the best known amphipod families, especially "mud shrimps" of the genus *Corophium*. The dorso-ventrally flattened body, huge second antennae and brush of long setae on the gnathopods are characteristic. *Corophium volutator* is often extemely abundant in intertidal sediments where it forms an important food source for birds and fish. It occurs on the mudflats of the Forth Estuary (eg. FRPB surveys at Kinneil) but surprisingly is not cited from the Forth by Lincoln (1979), who only mentions *Corophium affine, Siphonoecetes kroyeranus,* and *Unciola planipes* from the area. *C. affine* was recorded from St. Abbs and Bell Rock and *U. planipes* also from Bell Rock.

Family **Ischyroceridae**

Microjassa cumbrensis (Stebbing & Robertson, 1891)

St. Abbs Jun.'89 - 1 at stn.23. One of the smallest species of the family and difficult to identify. The single specimen collected appears to be the first record from the east coast of Britain.

Ericthonius rubricornis (Stimpson, 1853)

St. Abbs Jun.'86 -71 at st.1, Jun.'87 - 15 at stns.3,9, Jun.'88 - 10 at stn.1, Bell Rock Jan.'87 - 12 at stns.1,13. The genus *Ericthonius* was revised by Myers & McGrath (1984) who recognised four species from British waters. Of the species cited by Lincoln (1979), *E. brasiliensis* does not occur in British waters and records of this species probably refer to *E. punctatus* (Bate, 1857). *E. difformis* is present in British waters though the previous records of *E.difformis* from the Forth Sea area may possibly refer to *E.rubricornis* which has already been recorded in the Forth area by Moore (1984b).

Family **Podoceridae**

Paradulichia typica Boeck, 1870 [see Fig. 2c]

St. Abbs Jun.'87 - 3 at stns.11,13,23, Jun.'88 - 1 at stn.29, Jun.'89 - 1 at stn.15. Three specimens have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.8-10); immature female (1.75mm) St. Abbs, stn.23, Jun.'87, mature female (3.5mm) St. Abbs, stn.29, Jun.'88, immature female (2.5mm) St. Abbs, stn.15, Jun.'89. Some material has also been deposited in the British Museum (Natural History), London.

Dyopedos porrectus (Bate, 1857)

St. Abbs Jun.'87 - 2 at stn.11,15, Bell Rock Jan.'87 - 1 at stn.13., Bell Rock Oct.'89 - 1 at stn.13.

The family is generally recognised by the elongated urosomal 1 segment and the presence of only 1 or 2 pairs of uropods. *Dyopedos monacanthus* was also recorded from both St. Abbs and Bell rock. The two *Dyopedos* species are distinguished by the second gnathopods and by spines on coxal plates 1 or 2 of the males. However some small males of *D. monacanthus* were observed at St. Abbs without the characteristic coxal 1 spine. The discovery of *Paradulichia typica* above represents the first British record of this species which has an Arctic distribution in waters up to 550m deep. The genera *Dulichia* and *Paradulichia* were reviewed by Laubitz (1977).

Order: LEPTOSTRACA

Family **Nebaliidae**

Nebalia herbstii Leach, 1814 [Mauchline, 1984, as *Nebalia bipes* (Fabricius, 1780)]

St. Abbs Jun.'86 - 1 at stn.15, Jun.'87 - 4 at stns. 15,17,23, Jun.'89 - 1 at stn.11, Bell Rock Oct.'89 - 5 at stns.1,9. (Identity confirmed for 1989 specimens only)

Nebalia borealis Dahl, 1985

Bell Rock - 1 at stn.15, 1999.

Sarsinebalia typhlops (G.O.Sars, 1870) [Mauchline, 1984, as *Nebalia typhlops*]

Bell Rock Jan.'87 - 4 at stns.1,3, Nov.'87 - 2 at stns. 1,3, Apr.'89 - 2. stn? Four specimens, all from Bell Rock Jan.87, have been deposited in the National Museum of Scotland (Registration No. NMSZ 2001.012.11-14); 3 immature (2mm) stn.1, 1 mature (5mm) stn.3.

The only leptostracan noted by Mauchline (1984) in inshore waters was *Nebalia bipes* (Fabricius, 1780). Although this species is widely recorded around the British coast, even intertidally, the review by Dahl (1985) indicated that it is an arctic species and the only confirmed european records are from Iceland and northern Norway. It seems probable that most of the British records of *N. bipes* should in fact refer to *N. herbstii* Leach,1814. Indeed of the *N. herbstii* records from the disposal grounds, all were originally identified as *N. bipes* and only the specimens from 1989 have been re-examined and confirmed as *N. herbstii*. However, Dahl (1985), also described a new species, *N. borealis* Dahl 1985, with a more southern boreal distribution which includes southern Norway, Sweden, and the Shetland Isles. It is distinguished from *N. herbstii* by the acutely pointed (rather than rounded) denticles on the dorsal margin of sixth and seventh pleon segments. *N. borealis* has also now been found at the disposal grounds with a single specimen identified at Bell Rock, stn.15, in 1999, so it is possible some of the unconfirmed *N. herbstii* cited above may be *N. borealis*.

The occurrence of *Sarsinebalia typhlops* at the disposal grounds, with maximum depths around 60m, is somewhat surprising as Mauchline suggests it is restricted to deeper waters from 220-2900m. *S. typhlops* is readily recognisable by its minute unpigmented eyes and by its rostrum which is surmounted by a small, but distinct, apical spine.

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A NEW SPECIES OF PARASITIC COPEPOD *SPHAERONELLA GOTTOI* N.SP. (SIPHONOSTOMATOIDA; NICOTHOIDAE) FROM AN OSTRACOD COLLECTED OFF THE EAST COAST OF SCOTLAND

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INTRODUCTION

The Nicothoidae is a large family of copepods which now includes the family formerly known as the Choniostomatidae. They all parasitise other crustaceans with over 20 species known from British waters associated with lobsters, crabs, prawns, mysid shrimps, cumaceans, amphipods, and an ostracod (Green, 1958, Gotto & McGrath, 1980, Gotto, 1993). Recent re-examination of the only adult specimen from a British ostracod collected in 1987 by the present author off the east coast of Scotland, indicated that the original identification as *Sphaeronella monothrix* (Bowman & Kornicker, 1967) was incorrect and that the copepod in fact represents a species new to science. A full description of the new copepod is provided along with a discussion of its relationship to other ostracod infesting nicothoids.

The material was collected in the course of a benthic monitoring surveys of the sewage disposal grounds 13.5 km east of Bell Rock off the Fife coast. Sediment samples were collected by grab and sieved on 0.5mm mesh. The sieve residue was fixed with formalin before return to the laboratory where the fauna contained in the sample was extracted and identified. The brood pouches of any myodocopidan ostracods were checked for copepod parasites. (Among ostracods only myodocopidans brood their eggs and hence can act as hosts to *Sphaeronella* copepods.) The only species observed in the area was *Synasterope norvegica* (Sars, 1869), originally identified under its synonym *Cylindroleberis mariae* but now referred to *Synasterope norvegica* (see Angel, 1993).

Sphaeronella gottoi **n.sp.**

MATERIAL EXAMINED

1 mature female (Holotype) with 9 ovisacs from brood marsupium of *Synasterope norvegica* (Sars, 1869) (Fig. 1a), collected at Bell Rock disposal ground, Stn.3, (56 ° 26.00'N, 02°10.00'W), depth 51m, 27 Nov. 1987. Female and one ovisac permanently mounted on slide, host and remaining extruded ovisacs in vial. Deposited in National Museum of Scotland (Registration No. NMSZ.012.15).

1 pupa from brood marsupium of *Synasterope norvegica* (Sars, 1869) at Bell Rock disposal ground (Stn.9, 56°25.00'N, 02°13.62'W), depth 55m, 22 Jan. 1987, mounted on slide, but diagnostic features not discernible.

Etymology: The new species is dedicated to my colleague Dr R. Vivian Gotto, of the Queen's University, Belfast, in recognition of his contribution to the study of copepods associated with invertebrates in British marine waters.

DESCRIPTION

Female (Fig. 1b): Length 0.58 - measured as compressed on slide. Estimated non-compressed length 0.4-0.5mm. Ovisacs (Fig. 1a, c) ovoid detached from female, diameters (uncompressed) 0.36-0.46mm. Head (Fig. 1e) well defined from trunk. Lateral margins poorly defined from oral area, with two or three uneven longitudinal spinule rows. First antennae (A.1) structure difficult to discern; left antennae short, apparently two-segmented; proximal segment short, with single distal seta; second segment a little longer with seven setae and a cylindrical aesthetasc (chemosensory appendage) attached midventrally. Terminal seta possibly bifurcate, but perhaps may be two overlapping setae as detail not resolvable; right antennae details not observable. Second antennae absent. Oral disc encircled with filaments, with median incision ventrally and central aperture through which the tips of the mandibles (Md) are visible. First maxillae (Mx.1) details also difficult to see but apparently with two filamentous processes, directed anteriad and posteriad. Second maxillae (Mx.2) two-segmented; proximal segment robust with row of spinules adjacent to articulation with distal segment; distal segment tapered, curved, surmounted with weak process, and with fine setules subterminally and also at the tip.

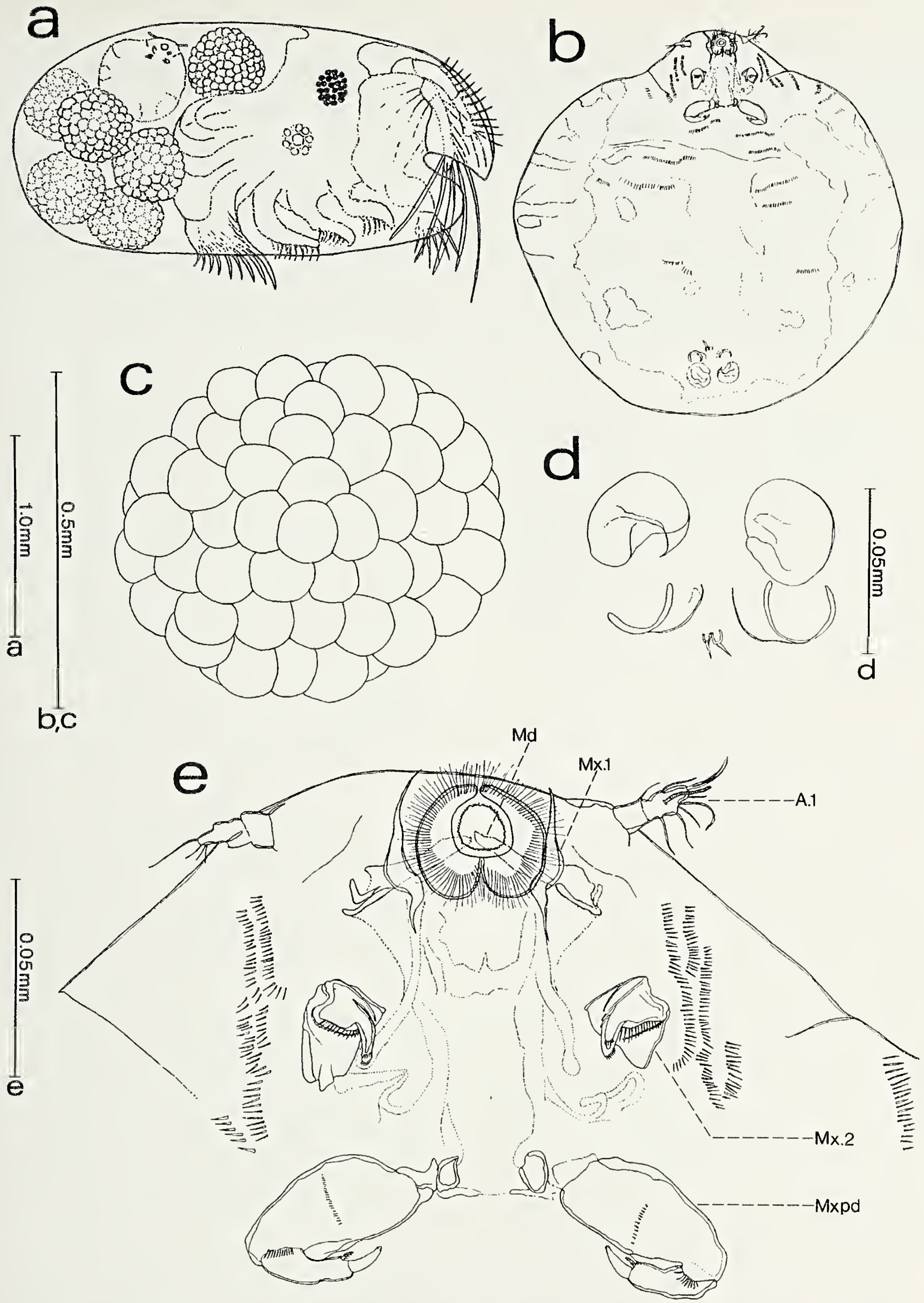

Figure 1: ***Sphaeronella gottoi*** **(Holotype), a) female and ovisacs in marsupium of ostracod** ***Synasterope norvegica,*** **b) Female habitus ventral, c) ovisac, d) female genital area and caudal rami, e) female head, ventral; A.1- first antenna, Md - mandible, Mx.1 - first maxilla, Mx.2 - second maxilla, Mxpd - maxilliped.**

Maxillipeds (Mxpd) three-segmented, first segment broad, with transverse row of fine setules medially and another row distally at the articulation with the second segment, second segment narrow with short spine distally on inner edge, third segment short curved with minutely toothed tip. Ratio of maxilliped segments approximately 5:2:1. The sub-median skeleton is visible ventrally (dotted). It is somewhat convoluted, extending from the base of the mandibles posteriad to the bases of the second maxillae and maxillipeds, with strongly chitinised nodules and a weak transverse bar between the latter.

Trunk spherical with a few transverse rows of minute spinules scattered round the body, dorsally and ventrally. Trunk legs absent. The genital area (Fig. 1d), comprises a pair of oval seminal recepticles and semi-circular genital apertures between which lie the caudal rami each composed of a single minute segment and short smooth seta (although right seta, shown as dotted is missing). Note in the habitus Figure (1b) the genital area and caudal rami are curled up dorsally and viewed through the body. Hence the caudal rami appear to be anterior to the genital area.

DISCUSSION

The first nicothoid copepod described from an ostracod was *Sphaeronellopsis littoralis* Hansen, 1905, found in sarsiellid *Sarsiella hispida* Brady from New Zealand. Hansen created a new genus for his species based on a prominant protuberance over the genital area, the elongated seminal recepticles, the fusion of the caudal rami into a single central stylet, and the unusual host group. Further ostracod-infesting *Sphaeronellopsis* species were described from off the eastern coast of the United States from cylindroleberid and philomedid ostracods (Bowman & Kornicker 1967, 1968) and from a cypridinid ostracod in the Peru-Chile trench system (Kornicker & Bowman, 1969). The largest single contribution to the study of ostracod infesting copepods was provided by Janet Bradford (1975) in her work on parasites of antarctic and subantarctic ostracods. She re-considered the status of the four *Sphaeronellopsis* species and re-assigned all, except for the type *Sphaeronellopsis littoralis*, to the large genus *Sphaeronella* Selensky, 1868, parasites of amphipods, isopods, and cumaceans. Bradford added fourteen new *Sphaeronella* species recorded from various cylindroleberid, cypridinid, philomedid, and sarsiellid ostracods, as well as *Sphaeronelloides vargulae* a new species and genus, also from ostracods, which is similar to *Sphaeronella* but lacking second maxillae and with only rudimentary maxillipeds. Only two further ostracod infesting nicothoids have been described since 1975; *Sphaeronella spinosa* Bradford, 1980 from the eastern United States and *S. squamosa* Yoo & Lim, 1996 from off the Korean coast.

Bradford (1975) placed the ostracod infesting *Sphaeronella* species into seven groups based on three features of adult females: the number of segments in the first antennae, the presence or absence of a second antenna, and the number of branches in the first maxilla. *S. gottoi*, with two-segmented first antenna, no second antenna, and two-branched first maxilla would be placed in the "*S. monothrix* Group", along with *S. anarthronis* Bradford, 1975, *S. philomedesi* Bradford, 1975, and also *S. spinosa* Bradford, 1980. These species are distinguishable from *S. gottoi* as follows:

The *S. monothrix* female appears to lack setules on the lateral margins of the head. It has a different antennal structure with a minute terminal second segment. The first maxillae branches are oriented anteriad and laterad. The second maxillae appear shorter and more coarsely toothed at the tip. The maxillipeds are similar in shape but lack setule ornamentation. The submedian skeleton, genital area, and caudal rami resemble *S. gottoi* but *S. monothrix* possesses two pairs of minute trunk legs which are entirely lacking in *S. gottoi* and other members of the "*S. monothrix* Group". The *S. anarthronis* female has more spinous head margins, anterior trunk, and genital area. The first segment of the maxilliped is proportionately much shorter and the submedian skeleton appears to have a quite different shape. The caudal rami also possess plumose setae. The *S. philomedesi* female has first maxillae branches oriented anteriad and laterad. The second maxillae appear shorter and more coarsely toothed at the tip. The maxillipeds are proportionately different, lack the distal spine on the second segment, and have a shorter more coarsely toothed distal segment. The submedian skeleton appears to be of a quite different shape. *S. philomedesi* also has a spinous genital area and caudal rami with plumose setae. The *S. spinosa* female also appears to have second maxillae which are shorter and more coarsely toothed at the tip. The maxillipeds are proportionately shorter with several spines distally on the second segment and two rows of robust teeth on the terminal segment. The submedian skeleton is poorly sclerotized, and like the two preceding species *S.spinosa* has caudal rami with plumose setae.

The small size of *Sphaeronella* copepods often presents observation difficulties. This may be compounded if limited material is available for study. Many descriptions are, like *S. gottoi*, based on a single specimen, which may be easily damaged during mounting. Moreover the orientation of a permanent mount may not always allow good observation of all the appendages, as is the case for the present specimen with respect to the antennae and first maxillae. Some of the finer morphological features are difficult to discern even with high magnification (x1000, phase contrast) and it should be borne in mind that published descriptions and illustrations may contain some errors. Despite these problems, sufficient detail of

S. gottoi is observable to establish it as a distinct species.

Most *Sphaeronella* copepods appear to be restricted to only one or two allied host species. Bradford (1975) considered that copepods parasitising the same ostracod family had some common features though this did not seem to be the case with those infesting cylindroleberids. However within the "*S. monothrix* Group", *S. monothrix* & *S. gottoi* infest cylindroleberids, *S. anarthronis* & *S. philomedesi* parasitise philomedids, and *S. spinosa* is associated with rutidermatids. One antarctic species, *S. synasterope,* infests the same ostracod genus as *S. gottoi,* but has few morphological features in common.

S. gottoi presently is the only ostracod-infesting nicothoid known in European waters. The record cited by Gotto (1993) of *S.monothrix* (Bowman & Kornicker, 1967) from south-east Scotland refers to the specimen described here, though the figures used by Gotto are of the genuine type description of *S. monothrix* from the New England coast. The recovery of further material of *S. gottoi,* including males, may help clarify the details of its morphology and elucidate its relationship with other members of the genus.

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AGABUS CHALCONATUS (COLEOPTERA, DYTISCIDAE) NEW FOR SCOTLAND

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The precise distribution of two closely related species of diving beetle, *Agabus chalconatus* (Panzer, 1796) and *A. montanus* (Stephens, 1828) has been in doubt for some time. The two species may be easily distinguished by the male genitalia, the parameres of which possess an apical brush of sucker hairs in *chalconatus*, these being wholly absent in *montanus*. However, the status of these species has been confused. *Agabus montanus* was known for many years as *A. melanocornis* Zimmermann, 1915, named as a variety of *A. chalconatus* and accepted as such by Balfour-Browne (1950). Fery and Nilsson (1993) demonstrated that Zimmermann's taxon was not the species without the sucker hairs on the parameres, and that it was necessary to resurrect Stephens' name *montanus* for this distinct species. Before recognition of the cryptic species pair, the complex was simply known as *chalconatus*, so old published records of this name have limited value. By way of further complication, it should be noted the unjustified emendation *chalconotus* Panzer, 1805 has occasionally been used instead of *chalconatus*.

Agabus chalconatus is a Western Palaearctic species ranging from the United Kingdom to North Africa and Iran. Balfour-Browne (1950) was only able to record it from England north to Mid-west Yorkshire and west to West Gloucestershire; it has subsequently (unpublished data) been found in the Northern Ireland. Foster (1982) reported it from Lazonby Fell, Cumberland, Wynyard Forest, County Durham, and Gosforth Park, South Northumberland; it has been found in North Northumberland by Dr M. D. Eyre subsequently (Figure 1). The known distribution is more or less continuous from there to the south coast. In Wales, it is confirmed only from Whitson, on the Welsh part of the Severn Levels. A record for Skokholm Island (Green, Pearson & Wilkinson, 1951) has been referred to *A. montanus* (Williams & Williams, 1978).

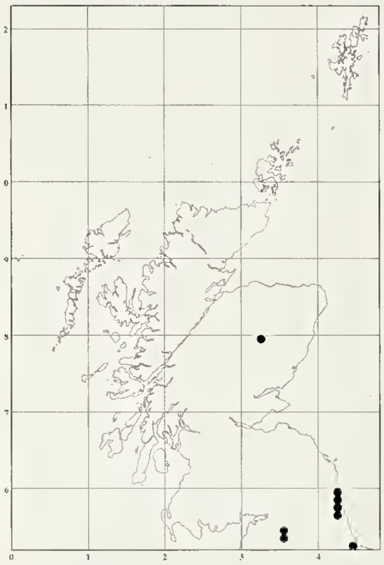

Figure 1. Distribution of *Agabus chalconatus* in northern Britain. Solid circles represent 10 km squares in which the species has been found, all records being from 1980 onwards.

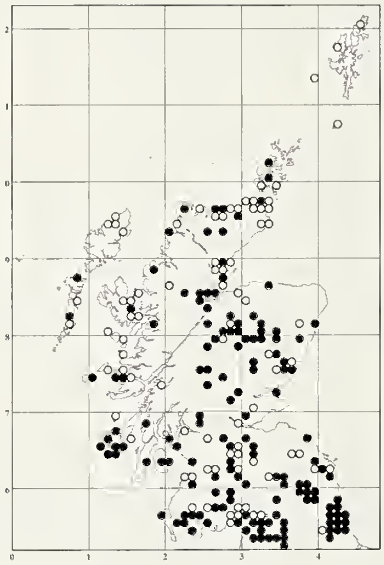

Figure 2. Distribution of *Agabus montanus* in northern Britain. Solid circles represent 10 km squares in which the species has been found from 1980 onwards, open circles representing earlier records.

A. montanus is a common species in Scotland (Figure 2) and much of western Europe, ranging to Sardinia, Sicily and Algeria. It is widespread in Ireland and Wales, but rather more confined in its distribution in England than *A. chalconatus*. The national recording scheme electronic data-base is largely complete for northern Britain and holds, at the time of writing, more than three times as many records of *montanus* (916) as of *chalconatus* (271).

The distributions in northern Europe are rather different. *A. montanus* is absent from Fennoscandia, but is recorded from Denmark and Lithuania (Nilsson & Holmen, 1995). *A. chalconatus*, on the other hand is widely distributed in Denmark, Sweden and is found in central Finland and all three Baltic States; it is, however, absent from Norway. On this basis, one might expect both species to occur in Scotland with, if anything, *A. chalconatus* being the more frequent species.

The purpose of this paper is to note the first record of *Agabus chalconatus* in Scotland, based on a male found just north of Crathie, South Aberdeenshire (VC92) on 20 June 2000. The specimen was netted in a shallow runnel in an area of base-enriched mire with broken cover provided by Scots Pine on the edge of a conifer plantation. A rather flat female specimen was also taken; this specimen had the metallic reflection without bronze reflections but had the apical four antennomeres weakly darkened, leaving its identity in doubt. A bronze female with only the most apical antennomeres distinctly darkened was almost certainly *chalconatus*. *A. montanus* males were taken in the same area, along with *A. congener* (Thunberg) and *A. bipustulatus* (L.).

Many attempts have been made to find *A. chalconatus* in the south of Scotland, and its first occurrence so far north is remarkable. *A. chalconatus* is rated as Nationally Scarce List B in Great Britain; there are records for 92 ten km squares since 1990, the threshold for loss of status being 100. Despite this marginal conservation status in Great Britain, the species merits special consideration within Scotland.

As noted here the species are often found together, particularly in woodland pools. However, *A. montanus* is more typical of acidic, exposed habitats whereas *A. chalconatus* is more frequent in shaded or grassy pools. The most important feature of the pools for both species would appear to be their impermanence and stagnancy.

It is interesting to note that the *montanus* males were teneral whereas the male specimen of *chalconatus* was fully hardened. Both species are regarded as having the type 3 life cycle proposed by Nilsson (1986) whereby semivoltine spring breeders enter the first winter as eggs and the second as adults. Carr and Nilsson (1988), in studying populations in Kent, found *chalconatus* larvae from November to January, whereas *montanus* larvae occurred from November to April. This suggests that the cycle in *chalconatus* is shorter than in *montanus*, with pupation in late winter or early spring.

ACKNOWLEDGEMENTS

I am grateful to Mr David Gibbs for supplying the Welsh record of *Agabus chalconatus*, and to Mr Andrew Foster for information on *A. chalconatus* in Northern Ireland. SAC receives financial support from The Scottish Executive Rural Affairs Department.

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AGROMYZID FLIES (DIPTERA: AGROMYZIDAE) NEW TO SCOTLAND, INCLUDING TWO NEW TO BRITAIN

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There appears to be no published records of the following species of agromyzid flies from Scotland. In addition two species are new to the British Isles. Nomenclature follows Chandler (1998).

Agromyza filipendulae Spencer, 1974

New to Scotland

This species with its characteristic linear leaf-mine in *Filipendula ulmaria* is widespread in Scotland, being known from vice-counties 72, 78, 79, 80, 82, 83, 88, 89, 90 and 91. First reared from leaf-mines collected on 13.ix.1992 at Mount Lothian (O.S. Grid NT2757), Midlothian (VC 83). Flies emerged 11.x.1992 (male genitalia checked).

A. frontella (Rondani, 1875)

New to Scotland

Reared from its characteristic leaf-mines in *Medicago sativa* collected at the site of the old railway station at Dalry (O.S. Grid NT2372), Edinburgh (VC 83) on 2.viii.2000. Flies emerged 25.viii.2000.

A. varicornis Strobl, 1898

New to Scotland

Leaf mines in cultivated sweet pea from Grange (O.S. Grid NT2672), Edinburgh (VC 83) on 24.ix.1992, produced adults of this species on 29.v.1993.

Cerodontha calamagrostidis Nowakowski, 1967

New to Scotland

Two male flies taken in a malaise trap at Carrifran Glen (O.S. Grid NT1513), Dumfriesshire (VC 72) on 23.vii.2000 proved to be this species. Identity confirmed from examination of male genitalia.

Chromatomyia luzulae (Hering, 1924)

New to Scotland

Abundant leaf-mines in *Luzula pilosa* in the Birks of Aberfeldy (O.S. Grid NN8547), Perthshire (VC 88) on 20.iii.1994, produced flies of this species between 7 and 12.v.1994. In spite of its abundance in this locality, I have failed to find it elsewhere.

Liriomyza cicerina (Rondani, 1875)

New to Scotland

The characteristic leaf-mines of this species in *Ononis repens* collected from Kincraig Point (O.S. Grid NT4699), Fife (VC 85) on 13.ix.1998 produced only parasites but examination of the spiracular structure of the puparia (see Spencer, 1976) confirmed them to belong to *L. cicerina.*

L. hieracii (Kaltenbach, 1862)

New to Scotland

Reared from leaf-mines in *Hieracium* sp. found on The Scorrie (O.S. Grid NO2775), Glen Clova, Angus (VC 90) on 3.viii.1992. Flies emerged 31.v.-4.vi.1993.

L. latipalpis Hendel, 1920

New to Scotland

Although this species feeds in *Triglochin maritima*, a puparium found attached to *Salicornia* sp. at Aberlady Bay (O.S. Grid NT4780), East Lothian (VC 82) on 25.x.1980, produced a fly of this species on 7.v.1981 (genitalia checked).

L. pisivora Hering, 1954

New to Scotland

Now known from three widely scattered localities in Scotland: Mines in *Vicia cracca* collected 9.ix.1984 at Boltonmuir Wood (O.S. Grid NT5168), East Lothian (VC 82) produced this species on 22.v.1985; mines in *Lathyrus montanus* collected on 31.viii.1990 at Glen Fender Meadows (O.S. Grid NN8967), Perthshire (VC 89) produced this species between 4 to 17.v.1991 and further mines in *Vicia cracca* collected 1.vii.1992 at Newtonmore (O.S. Grid NN7298), Inverness-shire (VC 96) also yielded it on 29.v.1993. The record from Glen Fender Meadows was originally published as *L. congesta* (Becker, 1903) by Bland (1994). This has proved to be a misidentification and *L. congesta* must now be deleted from the Scottish list.

L. pusio (Meigen, 1830)

New to Scotland

Leaf-mines in an unidentified species of grass collected at Learan (O.S. Grid NN5757), Rannoch, Perthshire (VC 88) on 15.vii.1993 produced flies of this species 1-26.viii.1993.

Melanagromyza aenea (Meigen, 1830)

New to Scotland

Puparia in large old stems of *Urtica dioica* collected at Stockbridge (O.S. Grid NT2474), Edinburgh (VC 83) on 15.viii.1998 produced this species.

M. angeliciphaga Spencer, 1969

New to Scotland & Wales

Internal stem mines in *Angelica sylvestris* from Crichton Glen (O.S. Grid NT3761), Midlothian (VC 83) on 3.v.1997 produced flies of this species on 25.v.1997. Similar mines were collected at Cors Geirch (O.S. Grid SH3235), Caernavonshire (VC 49), Wales on 24.v.1997 but the flies had already emerged. *M. angeliciphaga* has also been recorded from several further sites in VC 83, several sites in VC 88 and a single site in VC 85.

M. astragali Spencer, 1976

New to Britain

Reared from puparia in dead stems of *Astragalus glycyphyllos* collected at Steeple View (O.S. Grid TQ6890), near Basildon, Essex (VC 18) on 20.ii.2000. Single fly emerged on 21.v.2000.

Phytoliriomyza melampyga (Loew, 1869)

New to Scotland

Leaf-mines in *Impatiens glandulifera* collected at Stockbridge (O.S. Grid NT2474), Edinburgh (VC 83) on 15.viii.1998 produced flies of this species on 27.ix.1998. Leaf-mines also seen at Stanley, Perthshire (VC 88) and Kelvinside, Glasgow (VC 77).

Phytomyza aquilegiae Hardy, 1849

Confirmed Scottish

This species originally described by James Hardy presumably from Berwickshire (VC 81) is well established in gardens in the Edinburgh area (VC 83 & 84).

P. caulinaris Hering, 1949

New to Britain

Agromyzid larvae mining the stems of *Ranunculus repens* at Blackford (O.S. Grid NT2571), Edinburgh (VC 83) on 6.vii.1998 produced a single male fly of *P. caulinaris* on 19.vii.1998. Identity checked by examination of male genitalia (see Spencer, 1990).

P. cirsii Hendel, 1923

New to Scotland

Leaf-mines in *Cirsium arvense* collected at Linn Dean (O.S. Grid NT4659), East Lothian (VC 82) on 10.vii.1999, produced flies of this species on 31.vii.1999.

P. isais Hering, 1936

New to Scotland

Seedheads of *Odontites rubra* collected on the Isle of Iona (O.S. Grid NM2824), Inner Hebrides (VC 103) on 15.ix.1997 produced puparia of this species. Flies emerged 14-30.vii.1998. Also reared from *Odontites* seedheads from VC 82 & 84.

P. soenderupi Hering, 1941

New to Britain

Puparia found in old flower stalks of *Caltha palustris* by Dunalastair Water (O.S. Grid NN6858), Rannoch, Perthshire (VC 88) on 26.vii.2000, produced a fly of this species on 9.iii.2001 (puparia kept indoors). Further puparia collected from *Caltha* stems in a roadside ditch near Rawthey Bridge (O.S. Grid SD7197), Fell End, Cumbria (VC 69) on 5.viii.2000, emerged indoors on 8.i.2001. All puparia were found only in the old flower stalks, sometimes as many as 10 puparia per stalk - none were found in the petioles of leaves in spite of the statement in Spencer (1976). Identification is based on the morphology of the fly supported by the larval biology (Spencer, 1976). Also recorded from Kingsdale, Yorkshire (VC 64). As yet there are no published British localities for this species although it was added to the British list by D. Henshaw in Chandler (1998).

P. vitalbae Kaltenbach, 1872

New to Scotland

Leaf mines in *Clematis vitalba* growing in a garden in the centre of Fort William (O.S. Grid NN1073), Westerness (VC 97) on 3.xi.1998 produced flies of this species indoors on 15.xi.1998. Vacated mines were also seen at Carlops (O.S. Grid NT1656), Midlothian (VC 83) on 4.xi.1995.

These additions bring the list of species of Agromyzidae recorded in Scotland to 188 which represents just over half of the British known species.

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ADDITIONAL NOTES ON THE BARKLICE (INSECTA: PSOCOPTERA) OF THE LOTHIANS (SCOTLAND)

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A summary of the occurrence of 'barklice' (Psocoptera occurring out-of-doors) in the Lothians between 1994 and February 1999 was reported previously (Saville, 1999). Further recording between March 1999 and October 2000 has resulted in the discovery of two species new to the British list (Saville, 2001) and improved knowledge of the distribution and adult periods of most species. A total of 38 barklice species have now been found in the Lothians.

ADULT PERIODS

Current knowledge of adult barklice periods in the Lothians is shown in Table 1. The 'No. days' column is a count of the number of different dates on which the species were recorded. There is considerable variation in the length of the periods when adults are present in the different species; the length ranging from c.7 weeks (e.g. the univoltine *Metylophorus nebulosus*) to all year round (the polyvoltine *Ectopsocus* species).

At the end of February and during early March adults of only 3 species of barklice (all *Ectopsocus* species) have been found. In mid-March *Graphopsocus cruciatus* starts to appear followed a month later by *Elipsocus hyalinus*. The diversity of species doesn't increase much until June by the end of which the adults of 17 species can be found. In late July the adults of further species appear but August has the greatest species diversity with some 36 species of adult barklice being recorded. By the end of October the number has dropped to 13 and by the end of December, 8.

SPECIES DISTRIBUTION NOTES

Knowledge of the distributions of most barklice species has been extended following the additional fieldwork. Species which have been found to have the most localised distributions are as follows (number of recorded sites shown in brackets): *Peripsocus alboguttatus* (1), *Psococerastis gibbosa* (1), *Trichadenotecnum majus* (1), *Caecilius fuscopterus* (2), *Caecilius piceus* (2), *Ectopsocus axillaris* (2), *Elipsocus abdominalis* (3), *Elipsocus moebiusi* (3), *Loensia fasciata* (4), *Philotarsus picicornis* (4) and *Lachesilla pedicularia* (5). Some species warrant particular note:

Family **Caeciliusidae**

Caecilius piceus Kolbe, 1882 VC 83

This species is new to the Lothians. A single male specimen was found on a yew tree at Newbattle Woods (NT331656) on 26 Jul. 1999 and three female specimens were found on a yew tree at Ratho Golf Course (NT147708) on 20 Aug. 2000.

Family **Stenopsocidae**

Stenopsocus lachlani Kolbe, 1880 and *S. immaculatus* (Stephens, 1836)

In 1999 *Stenopsocus lachlani*, a species closely similar to *S. immaculatus*, was found to occur in Britain (Saville, 2001). *Stenopsocus* specimens are frequently found but because of the difficulty in separating the two species it has not proved possible to comment on their distributions.

Family **Ectopsocidae**

Ectopsocus axillaris (Smithers, 1969) VC 83

A second UK site for this species was located. The species was found in good numbers on a yew tree at Ratho Golf Course (NT147708) on 20 Aug. 2000. The golf course is situated 7.5 kilometres from the original site at Lauriston Castle (Saville, 1999).

Family **Elipsocidae**

Elipsocus moebiusi Tetens, 1891 VC 82, 83

This species was new to Britain when one female specimen was discovered on an oak tree at Mavisbank Estate (NT290653) on 31 Aug. 1999 and three females were found on birch trees at Sheeppath Glen (NT705707) on 31 Aug. 1999 (Saville, 2001). It has since also been discovered on deciduous trees at Dalmahoy Hill Plantation (NT142673) - one female specimen was found on 20 Aug. 2000.

Family **Philotarsidae**

Philotarsus picicornis (Fabricius, 1793) and *P. parviceps* Roesler, 1954

Table 1 Lothian adult barklice periods

Species	M	A	M	J	J	A	S	O	N	D	J	F	Adult period	No. days
Ectopsocus briggsi	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	All year	102
Ectopsocus petersi	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	All year	129
Ectopsocus axillaris	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	All year	9
Graphopsocus cruciatus	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	▬		14 Mar – 5 Jan	77
Elipsocus hyalinus		▬	▬	▬	▬	▬	▬	▬	▬				14 Apr – 3 Nov	51
Trichopsocus dalii			▬	▬	▬	▬	▬	▬	▬	▬	▬		17 May – 1 Feb	30
Epicaecilius pilipennis			▬	▬	▬	▬	▬	▬	▬	▬	▬	▬	19 May – 26 Feb	46
Mesopsocus immunis			▬	▬	▬	▬	▬						28 May – 4 Sep	35
Reuterella helvimacula			▬	▬	▬	▬	▬	▬					30 May – 7 Oct	11
Loensia fasciata				▬									1 Jun – 1 Jul	5
Mesopsocus unipunctatus				▬	▬								5 Jun – 28 Jul	22
Elipsocus pumilis				▬	▬	▬	▬	▬					5 Jun – 12 Oct	41
Stenopsocus immaculatus/lachlani				▬	▬	▬	▬	▬	▬				16 Jun – 30 Nov	52
Caecilius flavidus				▬	▬	▬	▬	▬	▬	▬			17 Jun – 22 Dec	63
Caecilius burmeisteri				▬	▬	▬	▬	▬	▬	▬	▬		20 Jun – 1 Feb	57
Stenopsocus lachlani				▬	▬	▬							21 Jun – 31 Aug	2
Peripsocus subfasciatus				▬	▬	▬	▬	▬					21 Jun – 27 Oct	22
Cuneopalpus cyanops				▬	▬	▬	▬						25 Jun – 9 Sep	7
Cerobasis guestfallica					▬	▬	▬	▬	▬	▬	▬	▬	1 Jul – 26 Feb	40
Stenopsocus immaculatus					▬								2 Jul – 20 Jul	2
Enderleinella obsoleta					▬	▬	▬						2 Jul – 7 Sep	7
Amphigerontia contaminata					▬	▬	▬						15 Jul – 19 Sep	8
Lachesilla pedicularia					▬	▬							18 Jul – 24 Aug	5
Epipsocus lucifugus					▬	▬	▬	▬					18 Jul – 4 Oct	7
Peripsocus phaeopterus					▬	▬	▬						22 Jul – 22 Sep	26
Philotarsus picicornis					▬	▬							26 Jul – 24 Aug	6
Philotarsus parviceps					▬	▬	▬	▬	▬				26 Jul – 9 Nov	24
Metylophorus nebulosus					▬	▬	▬						26 Jul – 21 Sep	17
Pteroxanium kelloggi					▬	▬	▬	▬	▬	▬			26 Jul – 16 Dec	9
Caecilius piceus					▬	▬							26 Jul – 20 Aug	2
Peripsocus didymus					▬	▬							27 Jul – 24 Aug	6
Trichadenotecnum sexpunctatum					▬	▬	▬	▬					27 Jul – 23 Oct	16
Amphigerontia bifasciata						▬	▬						3 Aug – 21 Sep	22
Caecilius fuscopterus						▬							6 Aug – 11 Aug	2
Peripsocus alboguttatus						▬							17 Aug	1
Elipsocus abdominalis						▬	▬						17 Aug – 4 Sep	3
Elipsocus moebiusi						▬							20 Aug –31 Aug	2
Trichadenotecnum majus						▬	▬						21 Aug – 13 Sep	2
Psococerastis gibbosa						▬	▬	▬					31 Aug – 12 Oct	2

Fieldwork carried out between March 1999 and October 2000 to determine the relative frequencies of the two known British *Philotarsus* species, *Philotarsus picicornis* and *P. parviceps*, has indicated that *parviceps* is much more widespread and abundant than *picicornis*. Only thirty specimens of *P. picicornis* were found at four localities where it was recorded on yew (15), western hemlock (13) and sycamore (2). In contrast, more than 1000 specimens of *P. parviceps* were found at 24 localities on a wide range of trees.

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SCOTTISH INSECT RECORDS FOR 2000

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The aim of this compilation is to bring together records of interest that have come to the attention of field workers active in Scotland during 2000. In the following list, specific names of Lepidoptera are as in Kloet & Hincks (1972) with some updating of nomenclature and the reference numbers as used in Bradley (1998). As these entries are numbered, following the well-established system initiated by Bradley & Fletcher (1979), family names have been omitted. The new checklist of the British Diptera (Chandler, 1998) has been used for that order. Other orders of insects follow the names that are given in Kloet & Hincks (1964, 1977, 1978).

Much of Scotland still lacks basic faunistic information in its more isolated parts for insects that may elsewhere be unremarkable and so not only 'rare' species are treated.

HEMIPTERA

MIRIDAE

Dicyphus epilobii Reuter. Dumbarnie links, Fife, on *Epilobium hirsutum*, (NO4402), Vc85, 17/8/00, GBC.

CICADELLIDAE

Aphrodes bifasciatus (L.). Benarty Hill, Fife, on *Calluna*, (NT1597), Vc85, 8/7/00, GBC.

PSYLLIDAE

Arytainilla spartiophila (Förster). Newburn, Fife, on *Cytisus*, (NO453035), Vc85, 17/7/00, GBC.

PSOCOPTERA

SPHAEROPSOCIDAE

Badonnelia titei Pearmann. Glasgow, caught in a pest-monitoring sticky trap inside museum building (NS565667), Vc77, 11/00, EGH. This species has been seldom recorded in Britain until recently when a survey of museums revealed it to be widespread in the northwest of England (Garland 1994). This is its first occurrence in Scotland.

NEUROPTERA

HEMEROBIIDAE

Hemerobius micans Olivier. Torry Bay LNR, Fife, (NT009863), Vc85, 22/6/00, BHL & SCS.

LEPIDOPTERA

518 *Coleophora mayrella* (Hübner) (= *spissicornis* (Haworth)). Torry Bay LNR, Fife, (NT009863), Vc85, 12/6/00, SCS.

797 *Neofaculta ericetella* (Geyer). Moss Moran, Fife, (NT170895), Vc85, 24/6/00, BHL.

815 *Scrobipalpa nitentella* (Fuchs). Torry Bay LNR, Fife, (NT009863), Vc85, 20/6/00, SCS.

843 *Aproaerema anthyllidella* (Hübner). Torry Bay LNR, Fife, (NT009863), Vc85, 19/6/00, SCS.

892 *Mompha subbistrigella* (Haworth). Torry Bay LNR, Fife, (NT009863), Vc85, 24/4/00, SCS.

1336 *Eudonia pallida* (Curtis). Torry Bay LNR, Fife, (NT009863), Vc85, 18/8/00, SCS.

1439 *Eurhodope advenella* (Zincken). Torry Bay LNR, Fife, (NT009863), Vc85, 25/7/00, SCS.

1545 *Colias croceus* (Geoffroy in Fourcroy) Clouded yellow. Many sightings over much of south west Scotland. Appeared in June, particularly around the Galloway and Ayrshire coasts, but also seen in Argyllshire, Mull and inland areas. Earliest records Dunman (NX096336), Vc74, 17/6/00; Port Mona (NX105326), Vc74, 17/6/00, R&BM. Second generation appeared in late August. Large numbers seen in many places, including Knockentiber (NS3939), Vc75, 22-25/08/00 (10+), JPB; Stevenston (NS256411), Vc75, 24/08/00 (10+), AMS; Low Drumskeog (NX3344), Vc74, 02/09/00 (72), Port Logan (NX0940), Vc74, 03/09/00 (12) J&IA; Balgray Reservoir (NS5156), Vc76, 04/09/00 (46), JW; Latest record Greenhead area (NS808544), Vc77, 03/10/00, JMcM.

1555 *Callophrys rubi* (L.) Green hairstreak. Commonhead Moss (NS6966), Vc77, 8-9/5/00, Isle of Cumbrae (NS1754), Vc100, 14/5/00, RS.

1590 *Vanessa atalanta* (L.) Red admiral. Fairly widespread, but generally in small numbers, although 24 seen at Myres Hill (NS5646), Vc76, 30/09/00, JW; earliest Port Mona (NX105326), Vc74 17/6/00, R&BM.; latest Hirsel (NT8240), Vc81 21/10/00, JW.

1591 *Cynthia cardui* (L.) Painted lady. Good number of records from much of southern Scotland. Earliest record Laggan (NX887563), Vc73, 28/05/00, R&BM; Latest record St Abbs (NT9168), Vc81, 14/10/00, JW.

1598 *Polygonia c-album* (L.) The comma. Low Drumskeog (NX3344), Vc74, 2/9/00, J&IA.

1600 *Boloria selene* (Denis & Schiffermüller) Small Pearl-bordered Fritillary. Darnley Mill (NS5258), Vc76, 8/00, GI.

1601 *Boloria euphrosyne* (L.) Pearl-bordered fritillary. North shore, Loch Melfort (NM8113), Vc98, 31/5/00, RB.

1614 *Pararge aegeria* (L.) Speckled wood. North Sannox, Arran (NS0146), Vc100, 22/7/00, ARS.

1629 *Aphantopus hyperantus* (L.) The ringlet. Darnley Mill (NS5258), Vc76, 8/00, GI.

1969 *Dyscia fagaria* (Thunberg) Grey scalloped bar. Moss Moran, Fife, (NT170895), Vc85, 2/7/00, BHL.

1972 *Agrius convolvuli* (L.) Convolvulus hawk-moth. Balmoral FPV Oil Rig (140ml NE of Aberdeen), found dead, 6/00, JT; Skipness, Argyll (NR85), Vc101, 1/10/00, found alive but died next day, RH; Polmadie, Glasgow (NS594624), Vc77, 2/10/00, found dead outside Fire Station, DW.

1984 *Macroglossum stellatarum* (L.) Humming bird hawk-moth. Large numbers, particularly around the Galloway and Ayrshire coasts in June. Also Cathcart, Glasgow (NS5861), Vc76, 21/06/00, JMcO.

2214 *Cucullia chamomillae* (Denis & Schiffermüller) Chamomile shark. Inchcolm, Fife, larva, (NT1882), Vc85, 11/7/00, GBC.

TRICHOPTERA

LIMNEPHILIDAE

Grammotaulius atomarius (Fabr.). Moss Moran, Fife, (NT170895), Vc85, 2/7/00, BHL.

SIPHONAPTERA

ISCHNOPSYLLIDAE

Ischnopsyllus simplex Rothschild. Ladybank, Fife, under bat roost, (NO313112), Vc85, 30/5/00, KC, det. GBC.

HYMENOPTERA

CIMBICIDAE

Cimbex femoratus (L.). Burnturk, Fife, in garden, (NO328074), Vc85, 21/7/00, AI, det. GBC.

TENTHREDINIDAE

Athalia cordata Lepeletier. Dumbarnie Links, Fife, on *Filipendula*, (NO4402), Vc85, 27/7/00, GBC.

Dolerus aeneus Hartig. Fleecefaulds Meadow, Fife, swept from *Juncus*, (NO399085), Vc85, 21/6/00, GBC.

D. gonager (Fabr.). Dumbarnie Links, Fife, dune grassland, (NO438023), Vc85, 28/4/00, GBC.

D. picipes (Klug). Dumbarnie Links, Fife, dune grassland, (NO438022), Vc85, 10/5/00, GBC.

Pachyprotasis rapae (L.). Dumbarnie Links, Fife, dune grassland, (NO438023), Vc85, 28/4/00, GBC.

Phytomatocera aterrima (Klug). Newburn, Fife, garden, larvae on *Polygonatum*, (NO453035), Vc85, 7/8/00, GBC.

Priophorus pallipes (Lepeletier). Newburn, Fife, garden, (NO453035), Vc85, 10/8/00, GBC.

Protoemphytus carpini (Hartig). Dumbarnie Links, Fife, on *Geranium pratense*, (NO438023), Vc85, 6/7/00, GBC.

Tenthredo acerrima Benson. Fleecefaulds Meadow, Fife, calcareous grassland, (NO399085), Vc85, 21/6/00, GBC.

T. schaefferi Klug. Dumbarnie Links, Fife, on *Heracleum*, (NO441022), Vc85, 18/7/00, GBC.

Tenthredopsis nassata (L.). Dumbarnie Links, Fife, dune grassland, (NO440022), Vc85, 18/7/00, GBC.

CYNIPIDAE

Aulacidea hieracii (Bouché). Roscobie, Fife, gall in stem of *Hieracium* sp., (NT092927), Vc85, 13/7/00, TB, det.GBC.

COLEOPTERA

CARABIDAE

Cicindela campestris Linn. Harris, Rum (NM3395), Vc104, 8/00, SB.

Cychrus caraboides (Linn.). Dibidil path, Rum (NM4196), Vc104, 8/00, SB.

Carabus granulatus Linn. Harris, Rum (NM3395), Vc104, 8/00, SB.

Carabus nemoralis Mueller. Kinloch, Rum (NM4099), Vc104, 8/00, SB.

Carabus problematicus Herbst. Askival, Rum (NM3995), Vc104, 8/00, SB.

Leistus fulvibarbis Dejean. Harris, Rum (NM3396), Vc104, 8/00, SB.

Nebria gyllenhali (Schoenherr). Hallival, Rum (NM3996), Vc104, 8/00, SB.

Broscus cephalotes (Linn.). Kilmory, Rum (NG3603), Vc104, 8/00, SB.

Bembidion atrocoeruleum Stephens. Kilmory Burn, Rum (NG3600), Vc104, 8/00, SB.

Pterostichus nigrita (Paykull) sensu stricto. Kilmory, Rum (NG3504), Vc104, 8/00, SB; Kinloch, Rhum (NM4099), Vc104, 8/00, SB.

Pterostichus strenuus (Panzer). Harris, Rum (NM3396), Vc104, 8/00, SB.

Calathus melanocephalus (Linn.) sensu stricto. Harris, Rum (NM3395); Kilmory, Rum (NG3603, NG3504), Vc104, 8/00, SB.

Calathus mollis (Marsham). Kilmory, Rum (NG3603), Vc104, 8/00, SB.

Synuchus nivalis (Panzer). Newburgh, Fife, arable, (NO244181), Vc85, 7/00, VH, det.GBC.

Agonum gracile Sturm. Harris, Rum (NM3395), Vc104, 8/00, SB.

Amara quenseli (Schoenherr). Hallival, Rum (NM3996), Vc104, 8/00, SB. Red Data Book status 'Nationally Scarce (A)'

Harpalus latus (L.). Lundin Links, Fife, coastal grass, (NO413024), Vc85, 7/00, GBC.

Harpalus quadripunctatus Dejean. Crieff, Perthshire (NN9017),Vc89, 6/00, LC. Red Data Book status 'Nationally Scarce (A)'

Bradycellus collaris (Paykull). Crieff, Perthshire (NN9025), Vc88, 5/00, LC.

NOTERIDAE

Noterus clavicornis (Degeer). South Gailes (NS3235), Vc75, 9/4/00, GNF. An uncommon species in Scotland apparently extending its range.

DYTISCIDAE

Hyphydrus ovatus (L.). Old Loudoun (NS4837), Vc75, 27/7/00, FW, det GNF; South Gailes (NS3235), Vc75, 9/4/00; Loch Libo (NS4355), Vc76, 11/6/00; Union Canal, Redding (NS9178), V.C.86, 7/6/00, GNF. Another species on the increase in southern Scotland.

Hydroporus ferrugineus Stephens. Spring near Dalleagles (NS5611), Vc75, 21/10/00, GNF.

Graptodytes pictus (Fabr.). Union Canal, Redding (NS9178), Vc86, 7/6/00, GNF. An uncommon species in Scotland.

Stictonectes lepidus (Olivier). Ardkinglass House (NN1710), Vc98, 29/4/00, TH, det GNF. Red data Book status 'Notable B', a species on the decline over much of Britain.

Ilybius aenescens Thomson. Muirshiel Pond (NS3461), Vc76, 10/8/00, JAM, det GNF. Red Data Book status 'Notable B'.

I. guttiger (Gyllenhal). Old Loudoun (NS4837), Vc75, 27/7/00, FW, det. GNF. Red Data Book status 'Notable B'.

Acilius canaliculatus (Nicolai). Newseat (NJ7420), Vc92. 6/10/00, TH, det. GNF. Red Data Book status '3'.

GYRINIDAE

Gyrinus aeratus Stephens. Barr Loch (NS3558), Vc76, 11/10/00, JAM, det GNF; Castle Semple Loch (NS3559), V.C.76, 30/7/00; Loch Libo (NS4355), Vc76, 11/6/00, GNF. Red Data Book status 'Notable B'.

G. opacus Sahlberg. Glen Muick (NJ7420), Vc92, 24/5/00, TH, det GNF. Red Data Book status Notable A'.

STAPHYLINIDAE

Aleochara curtula (Goeze). Dumbarnie Links, Fife, in carrion, (NO438022), Vc85, 28/4/00, GBC.

A. punctatella Motschulsky. Dumbarnie Links, Fife, tideline, (NO437022), Vc85, 27/12/00, GBC. This species has been added to the British list having been distinguished from *A. obsurella* Gravenhorst recently (Welch, 1997).

Amischa bifoveolata Mannerheim (= *A. cavifrons* Sharp). Dumbarnie Links, Fife, dune slack, (NO4302), Vc85, 13/12/00, GBC, det.CW.

Stenus flavipes Stephens. Lielowan Meadow Reserve, wet grassland, (NT090926), Vc85, 20/11/00, GBC.

SCIRTIDAE

Cyphon punctipennis Sharp. Old Military Road, Dalrulzion (NO1356), Vc89, 5/6/00, GNF, Red Data Book status 'Notable A'.

ELATERIDAE

Adrastus pallens (Fabr.). Newburgh, Fife, arable, (NO244181), Vc85, 7/00, VH, det.GBC.

Athous vitattus (Fabr.). Balmerino, Fife, on *Prunus spinosus*, (NO3524), Vc85, 14/5/00, GBC.

Denticollis linearis (L.). Newburn, Fife, on *Fraxinus*, (NO453035), Vc85, 18/6/00, GBC.

CANTHARIDAE

Cantharis nigra (Degeer). Fleecefaulds Meadow, Fife, calcareous grassland, (NO399085), Vc85, 18/6/00, GBC.

DERMESTIDAE

Anthrenus sarnicus Mroczkowski. Thornwood, Glasgow, in large numbers in a carpet in a house (NS5566), Vc77, 4/7/00, EGH. This carpet beetle was first noticed as British in c1962 (Edwards, 1969) and became a severe pest within the collections of The Natural History Museum, London, requiring considerable effort and expense to bring under control. This appears to be the first record in the Glasgow area although it has been seen occasionally elsewhere in Scotland.

COCCINELLIDAE

Rhyzobius litura (Fabr.). Dumbarnie Links, Fife, dune grassland, (NO4302), Vc85, 29/9/00, GBC.

Halyzia sedecimguttata (L.). Dumbarton, in garden leaf litter (NS386752), Vc99, 14/10/00, KF & SF.

MYCETOPHAGIDAE

Antherophagus nigricornis (Fabr.). Elie Ness, Fife, on *Lotus corniculatus*, (NT498995), Vc85, 30/6/00, GBC.

SCRAPTIIDAE

Anaspis regimbarti Schilsky. Newburn, Fife, on *Fraxinus*, (NO453035), Vc85, 17/6/00, GBC.

RHIPHORIDAE

Metoecus paradoxus (L.). Kirkintilloch (NS6674), Vc86, 5/10/00, MB, det. GNF.

CERAMBYCIDAE

Monochamus sartor (Fabr.). Hillington, nr Paisley, in warehouse (NS5165), Vc76, 23/5/00, CK. A European species found only as an occasional import.

CURCULIONIDAE

Barynotus moerens (Fabr.). Newburgh, Fife, arable, (NO246176), Vc85, 7/00, VH, det.GBC.

Ceutorhynchus pallidactylus (Marsham). Dumbarnie Links, Fife, Dune grassland, (NO438022), Vc85, 29/9/00, GBC.

Cidnorhinus quadrimaculatus (L.). Fleecefaulds Meadow, Fife, (NO400084), Vc85, 21/6/00, GBC.

Dorytomus taeniatus (Fabr.). St Andrews, Fife, on *Salix*, (NO502162), Vc85, 3/6/00, GBC.

Phyllobius viridicollis (Fabr.). Dumbarnie Links, Fife, dune grassland, (NO437023), Vc85, 9/6/00, GBC.

Trichosirocalus (=Ceuthorhynchidius) troglodytes (Fabr.). Lundin Links, Fife, coastal grass, (NO413024), Vc85, 5/4/00, GBC.

DIPTERA

TIPULIDAE

Tipula varipennis Meigen. Dumbarnie Links, Fife, (NO4302), Vc85, 5/00, GBC.

LIMONIIDAE

Limonia tripunctata (Fabr.). Dumbarnie Links, Fife, (NO4202), Vc85, 5/00, GBC.

CONOPIDAE

Conops quadrifasciata Degeer. Newburn, Fife, on flower of *Senecio jacobaea*, (NO453035), Vc85, 22/8/00, GBC.

NYCTERIBIIDAE

Nycteribia kolenatii Theodor & Moscona. Leslie, Fife, on *Myotis daubentonii*, (NO250015), Vc85, 22/5/00, KC, det.GBC.

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HISTORICAL SUPPLEMENT

The articles in this supplement have been specially written by members of Glasgow Natural History Society as part of the celebrations of the Society's 150th Anniversary. They provide both a record of the Society since its earliest days and personal reminiscences of some of the Society's activities and prominent members. The editor is very grateful for the work the writers have put into this task. I am especially indebted to Norman Tait for his expert preparation of the illustrations.

150 YEARS OF GLASGOW NATURAL HISTORY SOCIETY

(With Appendix 1, Historical articles published in the *Glasgow Naturalist* Appendix 2, Presidents, Editors, Secretaries and Treasurers since 1951)

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INTRODUCTION

The last time that the Society took stock of itself was the Centenary celebrations of 1951. These are described in the *Glasgow Naturalist* volume 17, part 1, published in 1951, and they make interesting reading. The main event was a month-long exhibition in Kelvingrove Museum, accompanied by film shows, lectures, excursions and a Thanksgiving Service in Glasgow Cathedral. The Society was then the Glasgow and Andersonian Natural History and Microscopical Society, the somewhat cumbersome name being the legacy of a complex history of amalgamations (see Richard Sutcliffe's historical review Ps 61-): the 100th anniversary of the Society's founding was justified by the Minutes of the inaugural meeting of one of the current Society's antecedents, the Natural History Society of Glasgow, held in the Temperance Hotel on 2nd July, 1851. The exhibition was a major affair, filling 39 cases and screens, and covering all the main sections of the Society's activities: botany (8 cases), microscopy (3), entomology (2), ornithology (5), zoology (5), geology (5), photography (3), and a miscellaneous set of cases on history, methods etc. (6). The *Glasgow Naturalist* republished John Lee's brief history of the Society, the President's introduction and a list of past Presidents, all from the exhibition catalogue and added a factual resumé of the natural history societies of Glasgow (by Donald Patton) and summaries of the public lecture and thanksgiving oration.

Fifty years on, the Society's Council has planned a rather different programme to celebrate our 150th anniversary. No-one suggested a church service (a comment on the growing secularisation of modern society?); we thought that to produce an exhibition to a sufficient standard would be too much work (a comment on busier lives? Or on higher expectations: in 1951, an exhibition could be dried plants in vases; these days, the general public would expect a high standard of presentation, which comes at considerable cost in time and money). We have gone instead for a major symposium on a key topic, linking basic natural history to conservation: the importance to our fauna and flora of alien species. We have also decided to write a more considerable historical review of the Society – its people and its activities as a supplement to the *Glasgow Naturalist*. Through articles in the *Glasgow Naturalist*, the Society has long valued a historical perspective. In appendix 1, I list the articles published in the last 100 years that are mainly historical in scope. The articles in this Supplement provide an update on our history. I hope readers find them as interesting as the writing team did in putting them together. In the remainder of this introduction, I take a look at how developments in GNHS relate to those elsewhere, in science, and in the world at large.

MEMBERSHIP AND SEX RATIO

The inaugural meeting of the Natural History Society of Glasgow was attended by nine 'gentlemen'. A minute of 14th September 1882 recorded approval for a proposal that women should be admitted to the Society, a progressive move for this era. In 1951, the membership was 230 of whom 38% were women. In 1955, the President (Robert Mackechnie) noted that the membership at 260 was the highest ever, but that at 1:4000 of the city's population, this was disappointing. , Since then membership has oscillated around the 200 – 300 mark, depending somewhat on the strictness of the treasurer in deleting lapsed members. In 2001, it is 248 with 41% women.

In some ways, it is quite an achievement to maintain membership at this level. GNHS has always attracted both amateur and professional natural historians, but its activities – mainly talks and excursions – are largely to do with self education and the pursuit of a leisure-time enthusiasm. These days there is a hugh proliferation of competing leisure time attractions (what percentage of the Glasgow population would have owned a television set, or a car in 1951, compared to now?); and even in the field of natural history, there are new organisations competing for members.

Though the Society was initially composed entirely of 'gentlemen', women have long played an important role. The Society elected its first female President in 1919, the same year that Lady Astor became the first female Member of Parliament (co-incidence or intent?). Unfortunately, there have been rather few since, only Elsie Conway in the 60's and Agnes Craib in the 80's. Only one woman, Mabel Scott, has edited the *Glasgow Naturalist* (Appendix 2). It is a different story if we look at the roll-call of Society Secretaries and Treasurers: perhaps woman prefer to take the hard-work back-room jobs and leave the more symbolic front-of-house tasks to mere men?

BALANCE OF INTERESTS

Natural history is a broad church, and the Society maintains a number of specialist sections, each with a convenor, to cater for the particular enthusiasms of members. It would be fair to note, however, that the predominant interest for some time has been Botany. From 1955-1990, the Presidents were all principally amateur or professional botanists, Geoff Hancock (1990-92) being the entomologist who broke the sequence. It will be fascinating to find whether this interest in botany in the Society can survive the sad but seemingly inexorable decline in academic interest in plant ecology and diversity, as seen in staff and student numbers in Scottish Universities. Perhaps it will be in Societies like GNHS that a heritage of interest in plants will be maintained.

For the more popular animal groups, birds especially, it is hard for a generalist society to compete with specialists like the SOC, RSPB and BTO. But, for the zoologist with broader interests, GNHS has much to offer. Geology is another field with strong specialist competition, and GNHS has struggled to maintain an active Geology Section.

Other sections have been devoted to techniques. Photography has long been an enthusiasm for members (see Norman Tait's account of changing techniques over the years, Ps 80-87); microscopy was an early interest, but as expensive new instrumentation became available, especially the electron microscope, microscopy as a technique went beyond the scope of the interested amateur. More recently, information technology has changed all our lives: GNHS bought its first computer in 1989, initially to assist with membership lists and the production of newsletters. But computers are ideally suited to the management of voluminous data sets and therefore to biological recording. Richard Weddle (Ps 88-99) recounts how the advent of sophisticated computer software has revolutionised the maintenance and manipulation of our local fauna and flora species lists, compared to the cumbersome methods of the past.

THE WIDER WORLD OF BIOLOGY

The big dates in GNHS history link quite closely to the major events in biological history. The founding of GNHS in 1851 precedes the publication of 'Origin of Species' by only 8 years. How quickly did Glasgow's naturalists become aware that the fundamentals of natural history had been revolutionised? (Answer: probably by 1868 – see later).

Fifty years after the foundation of GNHS, in 1901, Correns, von Tschermak and de Vries had just re-discovered Mendel's Laws of Heredity, and set up the programme which brought together, by the 1920's, an understanding of genetics, variation and natural selection: the neo-Darwinian Synthesis.

Our Centenary, 1951, occurred while Watson, Crick, Franklin and Wilkins were getting close to the structure of DNA, famously published by Watson & Crick in *Nature* with the 'modest' conclusion "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material". Science is occasionally punctuated by fundamental revolutions, and this was one of them, ushering in the set of techniques that have become molecular biology and making possible our rapidly expanding knowledge of genomes: the detailed codes that make up our sets of genes. In the years that we approached our 150th anniversary, the complete genomes of several organisms were published: of the plants, thale cress, *Arabidopsis thaliana* (Walbot, 2000); of the animals, *Caenorhabditis elegans* (The *C. elegans* sequencing consortium, 1998) and *Drosophila melanogaster* (Adams, 2000). Many others, including *Homo sapiens*, are on the way.

What impact have these major advances made on the activities of the Glasgow Naturalists? One way to assess this is to examine how our publications have changed, if at all. The *Glasgow Naturalist* and its predecessors (*Proceedings* and *Transactions*) have played several roles: first, they act as a record of the Society's activities: short accounts and talks, specimens presented and excursions. In recent years, most of this material has appeared in the Society's Newsletter rather than in the Journal, except where a lecture has been a work of substantial scholarship, meriting full publication. Second, they have provided a locus for the publication of new work on natural history, in the form of substantial papers and short notes, primarily as it relates to Scotland. This new work includes new records; ecological investigations; observations on behaviour, distribution, variation; historical changes; historical articles on naturalists and natural history.

In the time that I have been Editor, since 1996, only a single paper has been published that uses molecular methods that would have been unavailable in the past. This was Cameron *et al.*'s (1997) account of orchid colonisation, which used starch gel electrophoresis to analyse isoenzyme differences. A quick perusal of the journal back into the 19th Century tells the same story. Neither the molecular nor the genetic revolutions have made any impact on articles published in the "Glasgow Naturalist". Even the theory of evolution is hardly mentioned: Professor John Young addressed the 1868 AGM on the "present character of zoological research", explaining "the doctrine of Evolution as at present understood, and the mode in which development and genealogical succession are treated as synonymous" (*Proceedings* volume 1, 229). I have not checked the title of every lecture given since, but it does not seem that the Society has often felt the need for an update on the latest theories in biology.

It is apparent that both in its methodology (other than occasional use of recent microscopical methods such as scanning electron microscopy) and in its theoretical foundations, the work presented in the *Glasgow Naturalist* to-day could have as easily been presented a hundred years ago: there is no obvious sign of progress or change.

In many ways, this is not surprising. Basic distribution and recording work require good observation and natural history knowledge, rather than fancy new techniques, and many of the authors of work published in the *Glasgow Naturalist* are well-informed amateurs, rather than professional biologists. For the professionals, the *Glasgow Naturalist* is an excellent place to publish the straightforward local distributional data that other biological sciences journals tend to turn down these days. Nevertheless, I do find it a little disappointing that recent advances in biology make so little impact on what we publish. The modern sciences of Evolutionary Biology and Ecology can both be defined as *scientific* natural history: the seeking of *explanations* for the observations which natural historians make. Medawar (1965), writing before molecular biology had properly begun, had this to say about the 'good ecologist': "An ecologist in the modern style... working to understand the agencies that govern the structure of natural populations in space and time, needs much more than a knowledge of natural history and a map. He must have a good understanding of population genetics and population dynamics generally, and certainly of animal behaviour; more than that, he must grasp climatic physiology and have a feeling for whatever may concern him among the other conventional disciplines in biology (... immunology and endocrinology). There is no compelling reason why he should be able to talk with relaxed fluency about messenger – RNA, and it is not essential that he should ever have heard of it – though an unreasonable feeling that he 'ought' to know something about it is more likely to be found in a good ecologist than in an indifferent one". An updating of this passage would note that the reasons for the good ecologist to have some knowledge of molecular biology have become ever more compelling (as well as reminding Medawar that ecologists can specialise in plants as well as animals, and be female as well as male). Will this view make more impact on the work of GNHS as the society approaches its 200th year?

Another important strand in modern biology is conservation: the increasing threats to global biodiversity have spawned a new applied science which assesses these threats and attempts to devise procedures for the maintenance of species. *Glasgow Naturalist* has published papers with a conservation emphasis and our 150th Anniversary conference is squarely in this field. However, even conservation has made less impact on the work published by Glasgow's naturalists than might be expected.

One avenue which could lead to GNHS having more interaction with modern biology is through the Society's developing links with the Division of Environmental and Evolutionary Biology in the University of Glasgow. The Society has long had links with the University (many members of staff, mainly in Botany and Zoology, have been prominent members) but these have been strengthened by the location of the GNHS library and all meetings in the Graham Kerr building. As a longer-term result of the Society's 150th Anniversary, it has been decided to use the Blodwen Lloyd Binns bequest (see Downie, 1998 for an account of the bequest) to establish an annual series of prestige lectures in modern natural history, to be delivered jointly to GNHS and the Division of Environmental and Evolutionary Biology. It will be fascinating to see what impact these make on the Society and its activities.

ACKNOWLEDGEMENT

Thanks to Richard Sutcliffe for his comments on the manuscript, and to Richard Weddle for finding out some of the facts.

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Downie, J.R. (1998). Sowing the seed: the first 5 years of the Blodwen Lloyd Binns Bequest. *Glasgow Naturalist* **23(3)**, 1-2.

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The *C.elegans* sequencing consortium (1998). Sequence and analysis of the genome of *C. elegans*. *Science* **282**, 2012-18.

Walbot, V. (2000). A green chapter in the book of life. *Nature* **408**, 794-5.

APPENDIX 1 HISTORICAL ARTICLES PUBLISHED IN THE *GLASGOW NATURALIST*

(excluding articles in the Historical Supplement volume 23 (6), 2001)

Anon (1980). Naturalists in Glasgow No. 1: Sir William Jackson Hooker **20**, 24.
Anon (1981). Naturalists in Glasgow No. 2: David Douglas **20**, 122.
Anon (1982). Naturalists in Glasgow No. 3: Thomas Hopkirk **20**, 228.
Anon (1983). Naturalists in Glasgow No. 4: William Hunter **20**, 312.
Anon (1984). Naturalists in Glasgow No. 5: Roger Hennedy **20**, 388.
Braid, K.W. (1956). Dr James Cargill – an early Aberdeen Botanist **17**, 127-8.
Burns, J.H. (1993). David Ure (1749-1798). "Breadth of Mind and Accuracy of Observation". **22**, 259-75.
Curtis, E. W. (1998). The Natural history of the Glasgow Botanic Gardens: an historical introduction **23(3)**, 43-44.
Dance, S.P. & Reilly, M. (1998). The cautionary tale of Lister's Stromb **23(3)**, 9-15.
Dougall, M. & Dickson, J.H. (1999). The ancient oaks of Cadzow **23(4)**, 29-35.
Farow, G. (2001) – to come.
Ferguson, W. (1902). Reminiscences of the early days of the Natural History Society of Glasgow *Proc. & Trans.* 7 NS 9-17.
Grist, N.R. (1996). Peter Goodfellow **23(1)**, 57.
Hancock, E.G. (1992). Alexander Patience and his work on woodlice (Crustacea, Isopoda) in the Clyde Area, with a list of recorded species **22**, 133-9.
Macpherson, P. (1982). The doctrine of signatures **20**, 191-210.
Mitchell, J. (1985). The Reverend John Stuart, D.D. (1743-1821) and his contribution to the discovery of Britain's mountain flowers. **21**, 119-25.
Mitchell, J. (1992). Further notes on the Reverend John Stuart's contribution to the discovery of Britain's mountain flowers **22**, 103-5.
Mitchell, J. (1996). The legacy of the Loch Lomondside Wolf **23(1)**, 4-6.
Mitchell, J. (1998). Loch Lomondside depicted and described 1: Myths, marvels and monsters **23(3)**, 5-8.
Mitchell, J. (1999). The legacy of the Loch Lomondside Wolf – additional notes **23(3)**, 59.
Mitchell, J. (1999). Loch Lomondside depicted and described 2. Early maps and map makers **23(4)**, 2-8.
Mitchell, J. (2000). Loch Lomondside depicted and described 3. Early guide books for the scientific tourist **23(5)**, 3-6.
Mitchell, J. (2001) Loch Lomondside depicted and described 4. Early geologists and geomorphologists **23** (6), 4-8.
Paterson, J. (1913). Dante and Burns and their use of trees and birds **6**, 70-75.
Sutcliffe, R. (1985). Andersonian Naturalists' Society Centenary **21**, 99-100.
Sutcliffe, R. (1986). A hundred years ago: the Microscopical Society of Glasgow **21**, 125.
Woodward, F.R. (1991). William Buckham Lorrain, amateur malacologist and first vice-president of the Natural History Society of Glasgow **22**, 1-4.

APPENDIX 2 PRESIDENTS, EDITORS, SECRETARIES AND TREASURERS SINCE 1951

Presidents

(N.B. Presidents 1851-1948 are listed in the *Glasgow Naturalist* **17(1)**, 7.)

K.W. Braid	1949-1951
Donald Patton	1952-1954
William J. Cannon	1955
Robert Mackechnie	1955-1960
Basil W. Ribbons	1961-1963
Stephen A. Hutchinson	1964-1966
Elsie Conway	1967-1969
Alfred A.P. Stack	1970-1972
Allan McG. Stirling	1973-1975
James H. Dickson	1976-1978
Peter Macpherson	1979-1981
Agnes Craib	1982-1983
Peter Macpherson	1984-1986
James H. Dickson	1987-1989
E. Geoffrey Hancock	1990-1992
Norman R. Grist	1993-1995
Norman Tait	1996-1998
Robert Gray	1999-2001

Editors

Mabel G. Scott	1949-1954
W.D. Russell Hunter	1955-1963
Alan C. Crundwell	1963
Basil W. Ribbons	1964-1977
Eric W. Curtis	1978-1983
Ronald M. Dobson	1984-1995
J. Roger Downie	1996-2001

Secretaries

Jean Craig and Phyllis Woodland	1945-1955
Margaret McColm	1956-1957
Charles Morrison	1957-1959
Mrs A. Cross	1960-1961
Alfred Percy	1962-1967
John Scobie	1968-1972
Elizabeth Conacher	1973-1975
Agnes Walker	1976-1978
Elizabeth Conacher	1979
Margaret McLaughlin	1980-1981
Richard Sutcliffe	1981-1988
Norman Grist	1989-1991
Jean Millar	1992-1996
Morag McKinnon	1997-1998
Kirsty Kennedy	1999-

Treasurers

Robert Johnstone	1945-1956
Alexander Kennedy	1957-1961
Gerald Rodway	1962
Allan McG. Stirling	1963-1972
Peter Macpherson	1973-1977
Donald Clarke	1978-1981
Mrs E.L.S. Lindsay	1982-1989
Robert Gray	1990-1997
William Parkes	1998
Morag McKinnon	1999-

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GLASGOW'S NATURAL HISTORY SOCIETIES – AN UPDATE

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GLASGOW NATURAL HISTORY SOCIETY AND ITS ORIGINS

The last published histories of our own and other natural history societies in Glasgow were those of John R. Lee and Donald Patton, produced at the time of the Society's Centenary in 1951 (Lee, 1952; Patton, 1952). Since that time there have been many changes. However, before looking at what has changed, it is useful to be aware of some of the earlier history.

On 2nd July 1851, nine 'gentlemen interested in the pursuit of natural science' agreed to form a society under the name of **The Natural History Society of Glasgow**. These first members were eminent local naturalists of their day with a wide range of interests. William Gourlie (d.1856), the first President, was a botanist and conchologist. James Fraser was a geologist, Thomas Ferguson (d.1907) was an entomologist and ornithologist and his brother William Ferguson (d.1904) was a geologist and botanist. William B. Lorrain (d.1857) and Thomas Gray (1820-1910) were both conchologists and Thomas's brother John Gray (1828-1878) was chiefly interested in entomology. Robert Gray (1825-1887) was an ornithologist and later wrote *The Birds of the West of Scotland* (Gray, 1871), and his brother Archibald Gray (d.1873) was the other original member (Woodward, 1991).

Professor John Scouler (1804-1871) from Dublin addressed the Society within a week of its formation and was elected as the Society's first Honorary President. Roger Hennedy (1809-1876), who was later to write the *Flora of Clydesdale* - the first published flora of the area (Hennedy, 1865), also joined at this time. Over the next 150 years there would be many more eminent members (Fig. 2).

The Society met at 12 South Hanover Street until May 1852, when they moved to the Andersonian College (later the Royal Technical College and now Strathclyde University) on George Street. This was to be their home for many years.

The Natural History Society of Glasgow was not the only such organisation to be formed in Glasgow. Several other societies existed at the same time, and several of them eventually merged with the Natural History Society of Glasgow.

The **Glasgow Naturalists Society** was founded in 1858. They amalgamated with the Natural History Society in 1866. One volume of their 'Manuscript Magazine' from 1863 containing some marvellous illustrations (Fig. 1, front cover) survives in our archives. Such 'publications' were hand-written, and were passed from member to member.

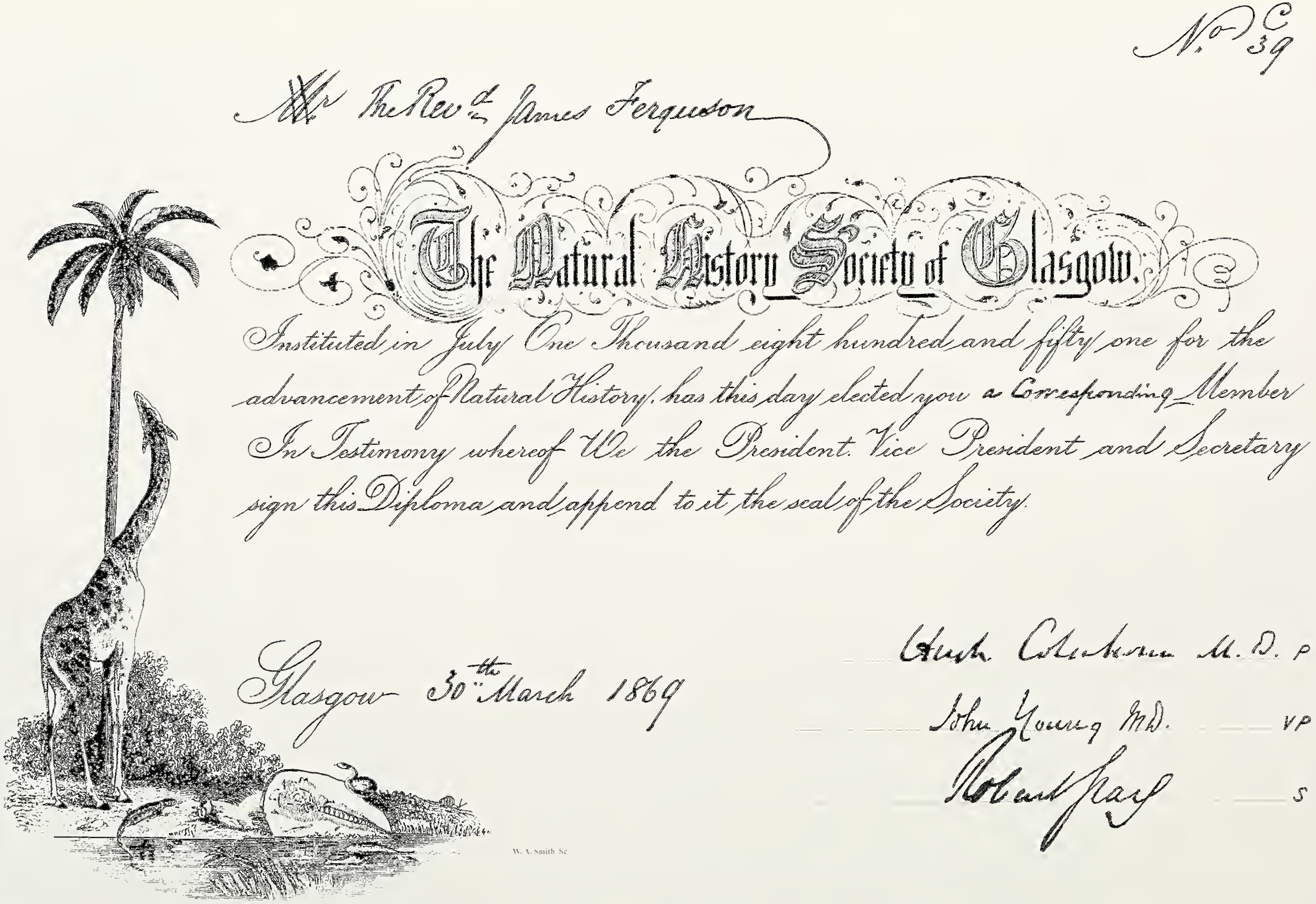
The **Glasgow Society of Field Naturalists** (Fig. 3) was founded in 1871 and produced the 'List of the Fauna and Flora of Clydesdale and the West of Scotland' for the 1876 meeting of the British Association in Glasgow. They also published an Annual Report and Transactions. Their President was the eminent botanist, James Stirton (1833-1917). They amalgamated with the Natural History Society of Glasgow in 1879.

In 1883 the **Glasgow Practical Naturalists Society** was formed in the old Kelvingrove Museum principally for the practical study of the entomology of Clydesdale. One of their objects was also to prepare a catalogue of insects taken in Scotland. They do not appear to have kept their name for long and by 1886 they had taken the name of **Clydesdale Naturalists Society** (which had previously existed under the aegis of the Glasgow Philosophical Society from 1850-1865). They also merged with the Natural History Society about 1890.

The **Glasgow Eastern Botanical Society**, formed in 1876, merged with the Natural History Society in 1898. A few botanical specimens collected by members of this Society still exist in the collections of Glasgow Museums (Fig. 4).

Following a series of botany evening classes run in the Andersonian College, 16 gentlemen decided to form a society in August 1885. At the suggestion of the governors of the College they took the name 'Andersonian' to avoid confusion with the Natural History Society of Glasgow, and so the **Andersonian Naturalists Society** came into existence. The 'Andersonians' considered themselves very much 'amateur' naturalists, as opposed to the more academic Natural History Society. However, over the following years, several individuals were members of both societies.

In 1886 the **Microscopical Society of Glasgow** was formed by enthusiasts from Mr. J.C.Christie's Geology Class, also at Anderson



No. C 39

~~Mr~~ The Revd. James Ferguson

The Natural History Society of Glasgow.

Instituted in July One Thousand eight hundred and fifty one for the advancement of Natural History, has this day elected you a Corresponding Member

In Testimony whereof We the President. Vice President and Secretary sign this Diploma and append to it the seal of the Society.

Glasgow 30th March 1869

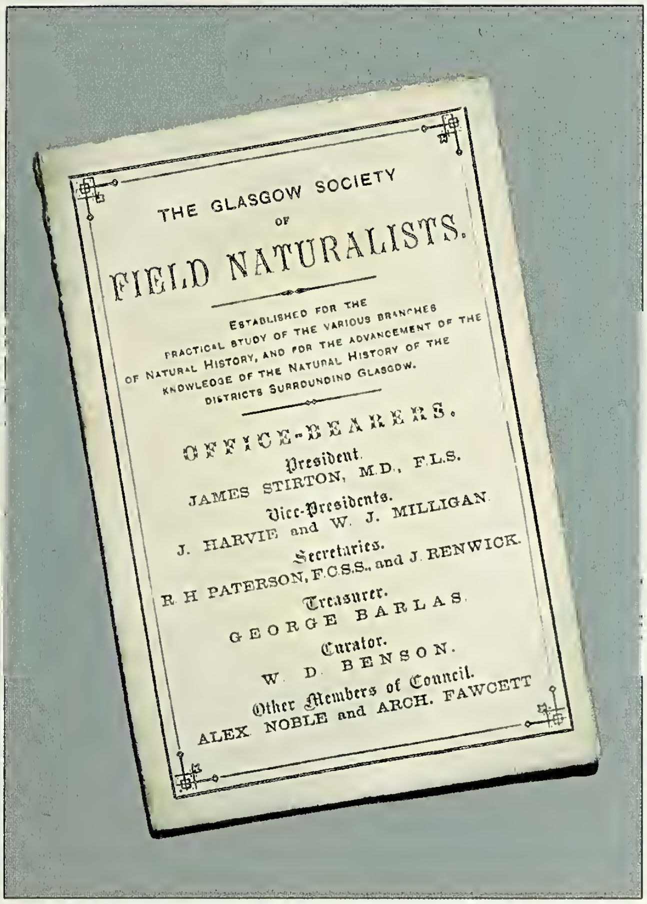
Hugh Colquhoun M.D. P

John Young MD. VP

Robert Gray S

W. A. Smith Sc

Fig. 2 A reproduction of a membership certificate for a corresponding member, James Ferguson (1869). The certificates were clearly quite elaborate documents, though whether the fauna and flora used to embellish them were appropriate is open to question. A seal was attached at the bottom. This certificate was signed by Hugh Colquhoun (see Eric Curtis's paper), John Young and Robert Gray.

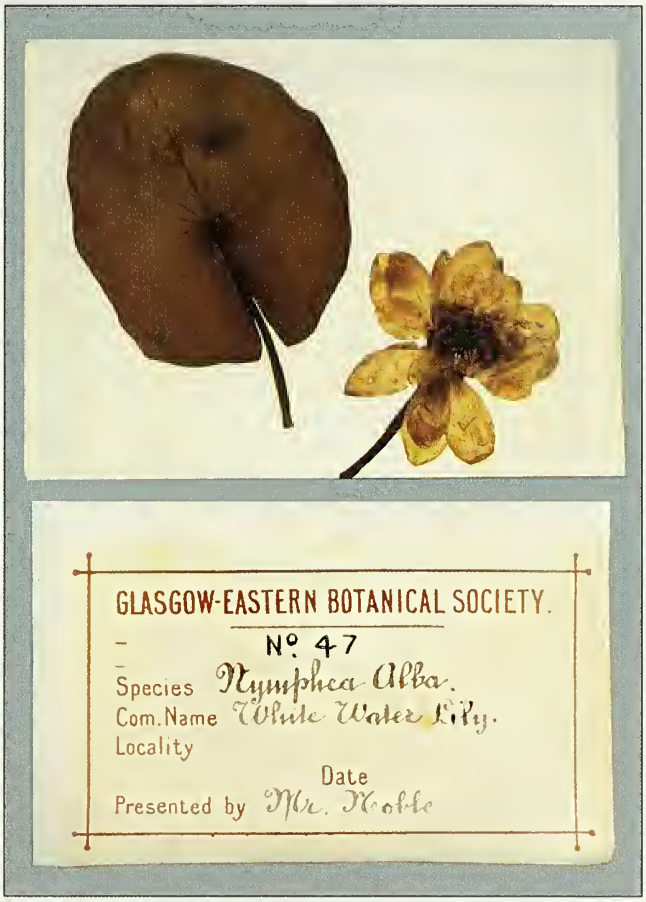


THE GLASGOW SOCIETY
OF
FIELD NATURALISTS.

ESTABLISHED FOR THE
PRACTICAL STUDY OF THE VARIOUS BRANCHES
OF NATURAL HISTORY, AND FOR THE ADVANCEMENT OF THE
KNOWLEDGE OF THE NATURAL HISTORY OF THE
DISTRICTS SURROUNDING GLASGOW.

OFFICE-BEARERS.
President.
JAMES STIRTON, M.D., F.L.S.
Vice-Presidents.
J. HARVIE and W. J. MILLIGAN.
Secretaries.
R. H. PATERSON, F.C.S.S., and J. RENWICK.
Treasurer.
GEORGE BARLAS.
Curator.
W. D. BENSON.
Other Members of Council.
ALEX. NOBLE and ARCH. FAWCETT

Fig. 3 Syllabus from the Glasgow Society of Fields Naturalists



GLASGOW-EASTERN BOTANICAL SOCIETY.
Nº 47
Species Nymphea Alba.
Com. Name White Water Lily.
Locality
Date
Presented by Mr. Noble

Fig. 4 Herbarium specimen from the Glasgow Eastern Botanical Society

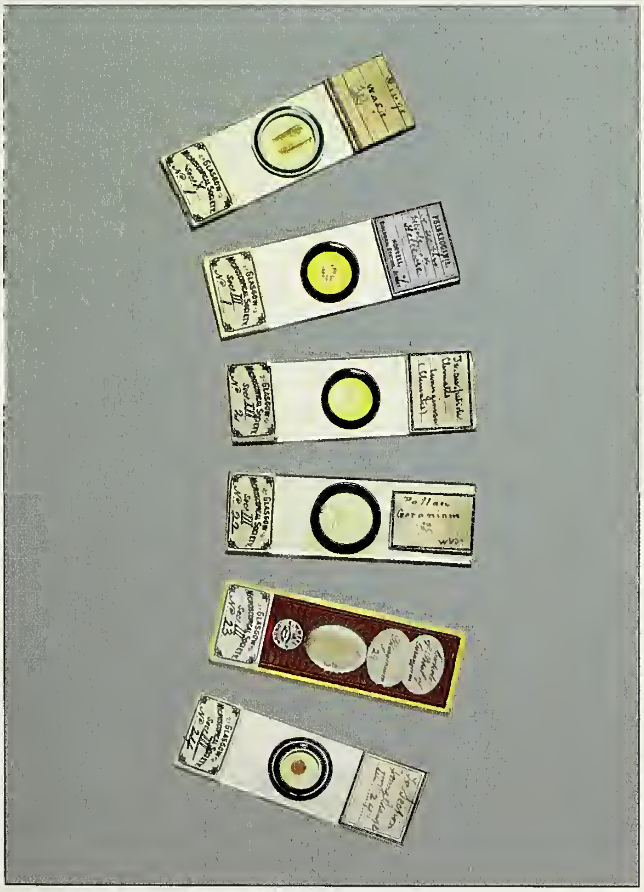
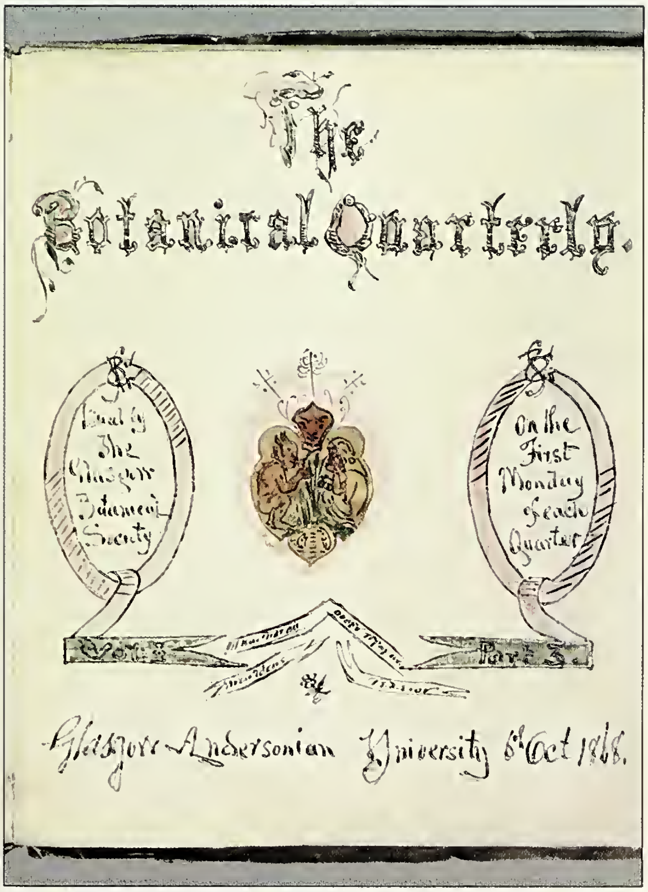


Fig. 5 Microscope Slides from the Microscopical Society of Glasgow



The
Botanical Quarterly.

Read by
The
Glasgow
Botanical
Society

On the
First
Monday
of each
Quarter

Vol. 1
Part 3.

Glasgow Andersonian University 6th Oct 1868.

Fig. 7 Cover from the *Botanical Quarterly*, 1868 produced by the Glasgow Botanical Society

College. The Society was formed 'for the purpose of popularising the use of the microscope as a recreation, of affording incentives to students of nature to engage in original research and to give opportunity for mutual aid by means of meetings at which papers are read, demonstrations given and objects of interest examined.' (See Sutcliffe, 1986 for a longer account). Fig. 5 shows examples of slides made by members of the Society.

In 1901 the Natural History Society of Glasgow celebrated its jubilee and Glasgow also hosted the 1901 meeting of the British Association for the Advancement of Science. A special meeting was held in the Masonic Hall, West Regent Street in December with representatives from 'kindred societies and other bodies' to celebrate the Society's first 50 years (Anon, 1902). Numerous speeches were made and congratulatory telegrams read out from notable naturalists and societies from all over Britain.

In the late 1920s it was apparent that the three societies - the Natural History Society of Glasgow, the Andersonian Naturalists Society and the Microscopical Society of Glasgow were all pursuing very similar aims and so it was agreed to amalgamate into one entity. In 1931 they became the **Glasgow and Andersonian Natural History and Microscopical Society**. This name was shortened to the **Andersonian Naturalists of Glasgow** in 1956. Many older members still refer to the Society as 'the Andersonians'. There was some concern in the late 1970s that some members of the public were mis-interpreting the name 'Andersonian Naturalists' as 'Andersonian Naturists', with its associated connotations , so together with the need to better publicise the society, the name was again changed in 1979 to its current name of **Glasgow Natural History Society**.

The Society has received two notable bequests in its long history. The first was the Goodfellow Bequest , which started off as a £100 legacy left by Peter Goodfellow (1887-1933), a former Secretary of the Microscopical Society, in 1933 (King, 1936). The original idea was for the money to be used to pay for regular lectures on a subject related to microscopy. By the 1980s, Goodfellow lectures no longer took place and the fund had become a virtually worthless entry on the annual balance sheet. It was therefore agreed to wind up the fund following a lecture in 1990 (Grist, 1996), but it was also agreed that the Society should still try to hold Goodfellow Lectures on a biennial basis.

In 1991, one of our longest-serving members, Prof. Blodwyn Lloyd Binns, died and left the Society her entire estate, worth in the region of £200,000. As a result, the Blodwyn Lloyd Binns (BLB) Bequest was set up with Trustees to administer the funds. The capital has been well invested and the Trustees have made available the interest from the investments to benefit the work of the Society and its members. This has made it possible to pay for top quality speakers to come to Glasgow, buy computer equipment, new books for the library, have colour photographs in the *Glasgow Naturalist* and to give numerous grants to members for a wide range of projects and research (Downie, 1998). In addition, another long-standing member of the Society, Mabel Scott, who died in 1998, left a bequest of £1000 to the Society.

In the 1970s the Society held its meetings in both the University of Strathclyde and the University of Glasgow. Since the early 1980s, apart from a short period in the Art Gallery & Museum, Kelvingrove, meetings have been held almost exclusively in the University of Glasgow. The first venue was the Zoology Department, then the Botany Department, and then the Boyd Orr Building before returning to Zoology (now called the Graham Kerr Building) in 1999 The annual exhibition meeting was for many years held in the Art Gallery & Museum, Kelvingrove, but for the last few years it too has taken place in the University.

The Society's library was, for over 100 years, housed in the City's Mitchell Library. By the 1990s it had become clear that the Mitchell Library no longer had sufficient room for the Society's books and following the sale of duplicate and surplus books, the library moved to the Graham Kerr Building of the University of Glasgow in 2000. With money from the BLB Bequest for the provision of many new books together with those given in exchange for reviews in the *Glasgow Naturalist*, the library is again a useful resource for members. It is now housed in the same building where most of the meetings take place, making it much more aceessible than in the past.

Throughout the Society's history it has had 'Corresponding members' who kept in touch with the Society, but rarely attended meetings. This is still much the same today, although they are nowadays just 'ordinary' members. Some simply join to receive the *Glasgow Naturalist*. Others are keen to keep in touch with what has been happening in the natural history world around Glasgow.

Since its earliest years, the Society has had different sections with sub-committees to run them. Most of these have been the traditional divisions you would expect - botany, entomology, geology, ornithology, zoology etc. Today, however, we also have a computer section, which is arguably the most important section of all. The Society's computer is used for producing newsletters, posters, membership information etc. as well as for the major work being done on biological recording (See Richard Weddle's article pp). GNHS is now also accessible on the internet at www.gnhs.freeuk.com. The Society has come a long way since 1988, when the regular billets and newsletters were typed onto stencils for duplicating!

The last anniversary the Society celebrated was in 1985 with the centenary of the 'Andersonian Naturalists' Society with an exhibition in the Art Gallery & Museum, Kelvingrove and a special excursion to Stonelaw Wood, Rutherglen. This was followed by a dinner at Carmunnock, with members dressing up in period costume for the occasion (Fig. 6, back cover).

In the last 50 years the Society has changed its name twice and has undergone major changes to bring it well and truly into the 21st century. It owes a debt of gratitude to all the many office bearers and members of Council over the years who have worked so hard behind the scenes to make everything run smoothly in our rapidly changing world. But, 150 years on, it still retains its original aims – *'to encourage the pursuit of Natural History in all its branches, and to foster a love of this science, by meetings for the exhibition of specimens both native and foreign, the reading of communications, and excursions for mutual improvement.'* Long may it continue.

OTHER GLASGOW SOCIETIES

Patton (1952) mentions a few other local natural history societies which have co-existed with the Natural History Society of Glasgow: The Glasgow Philosophical Society, Glasgow Botanical Society, the original Clydesdale Naturalists' Society, Geological Society of Glasgow, The Glasgow Royal Botanical Institution, the Glasgow Zoological Society, and the Union Jack Field Club.

GNHS's archives include the *Botanical Quarterly*, produced from 1868 by the **Glasgow Botanical Society** (Fig. 7). Like the Glasgow Naturalists' Manuscript Magazine, these 'publications' are hand-written, and were passed from member to member. The editor of the '*Botanical Quarterly*' obviously had a sense of humour as he wrote in its first issue that '...*The price of this magazine has been fixed as low as it possibly could, indeed when we state that the conductors have determined to issue the first numbers at the low figure of 0/0 the public will be prepared to believe our statement.*'

One organisation which was not mentioned by Patton was the **Sylvan Ramblers**, founded in 1885. Whilst not a natural history society as such, they were very interested in natural history. One of their members (Mr James White) even gave a lecture on geology to them in January 1886. They produced two volumes of publications (Anon 1886, 1892). Most of the minutes describe the rambles themselves with interesting historical information and descriptions of places now much changed. They visited a variety of places throughout the Glasgow area and as far afield as Largs, Edinburgh, Aberfoyle and Loch Awe. There were a few passing remarks about the natural history. The publications were produced '... *to recall to the minds of the members, the various scenes and circumstances which have been to them a source of so much pleasure, in wandering amongst the beauties of Nature, when they have been able for the time being to throw off all the cares and pressures of business which oftimes weigh heavily upon those engaged in the struggle of life'*. A statement which could just as easily apply to GNHS outings today!

In the last 20 or 30 years, with more leisure time available, many people have become involved with wildlife-related organisations. Many National Societies have grown and have in effect taken on the role of local natural history societies. For example, the **Scottish Wildlife Trust (SWT), Royal Society for the Protection of Birds (RSPB), Scottish Ornithologists Club (SOC), Friends of the Earth** and **Butterfly Conservation,** all have local groups or branches and run meetings and excursions locally. Many GNHS members belong to several of these wildlife organisations which generally get on well and sometimes organise joint excursions etc. The RSPB run Wildlife Explorers and Phoenix groups for younger members in the Glasgow area.

In 1982 the **Glasgow Urban Wildlife Group (GUWG)** was formed to act as an information exchange between all the various wildlife organisations and individuals interested in the City's wildlife, and be an umbrella group for all. GUWG tried for many years to build a wildlife garden in the west end of Glasgow and also actively campaigned for the retention of Auchenshuggle Wood in the east end of the city.

They promoted an Urban Wildlife Week, which led on to an annual 'Wildfare' event where all the local environmental organisations had stands to advertise their organisations. For several years this was run by the SWT. GUWG's most substantial achievement was to be part of the consortium that built and staffed Oor Wullie's wildlife garden at the Glasgow Garden Festival (1988). Some of the plants and the boardwork ended up at Mugdock Country Park. GUWG later changed its name to the **Greater Glasgow Urban Wildlife Forum** (GGUWF). It has not been active since 1998.

GUWG produced a newsletter which became *City Wild* and was for a short time around 1988 called *The Puddockstool* and produced by the Glasgow Urban Spaces Initiative (GUSI) - a Community Programme Scheme project based in the Glasgow College of Technology. This newsletter gave details of many wildlife-related events happening in Glasgow. In the 1990s, Community Service Volunteers, Scotland (CSV

Scotland) took over this role with their *Green Diary*, a free monthly digest of all 'green' events in and around the city. Sadly, due to lack of funding, this was last published in January 2001.

The **Friends of the River Kelvin** (FORK) were formed in 1991. There aims are to protect, conserve and preserve for the benefit of the public, the River Kelvin, its tributaries and immediate environs and to advance public education in the history, geology, geography and other features of the River Kelvin and the Kelvin Valley. There is much interest in the wildlife of the Kelvin. Several members have a specific interest in natural history and many articles have been written on the River's wildlife in their newsletter *Fork News*.

Other organisations have an interest in natural history, but do not claim to be natural history societies. These include the **Friends of Glasgow Botanic Gardens**, and the **Glasgow Tree Lovers Society**.

There are also three children's clubs with an emphasis on natural history run by the Glasgow City Council's Countryside Ranger Service, based in Glasgow Parks. They are called **The Wild Bunch** (Pollok Country Park), the **Linn Dippers** (Linn Park) and **The Ecos** (Tollcross Park). Some of these are potentially the GNHS members of the future!

ACKNOWLEDGEMENTS

I am grateful to Dr J.A. Gibson for alerting me to the existence of the Sylvan Ramblers, and to Steve Edwards for information about GUWG.

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GLASGOW NATURALIST Vol. 23 Part 6 pp 68-73 (2001)

EVOLUTION OF THE *GLASGOW NATURALIST*: FROM THE "MISSING PROCEEDINGS" TO MODERN TIMES

(With Appendix of extracts and illustrations from the society's journals)

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The origins of today's *Glasgow Naturalist* can be traced back to volume I of the *Proceedings of the Natural History Society of Glasgow* (1858-69). This begins with an account of the Society's 8th Annual General Meeting, held on 27th September, 1859. What happened to the earlier Proceedings, you might ask? Jack Gibson's note on the "missing Proceedings" (Ps. 74-9) gives the answer.

The contents list of this first volume was by topic, in alphabetical order, compiled once the whole volume was complete, and covering the activities of nine sessions, 1859-60 to 1868-69. The contents covered the proceedings of each Society meeting: chair, election of new members, specimens exhibited and the paper read - usually in abstract only, but occasionally in full. Most of the papers were accounts of fieldwork: they never included citations to other work, and rarely included illustrations, though this first volume did have some colour figures (see Fig. 2 for a reconstruction of one of the original hand-tinted illustrations). The Proceedings also included the Society's annual membership list, the office-bearers (no editor is listed: presumably the secretary put the Proceedings together and dealt with the printer - reports of progress on printing occur frequently at meetings), and the Bye-Laws.

This pattern of publication continued till Volume V (1880-1883), and concluded with a very detailed index to these first five volumes. Volume IV included two substantial papers, the first in a proposed series on the Fauna of Scotland (see Ps. 100-3 for article by J.A. Gibson on the *Fauna of Scotland* series).

A new Constitution was passed in 1884 and included a re-naming of the journal as the *Proceedings and Transactions of the Natural History Society of Glasgow* (our forebears loved long journal titles!). This new format appeared in eight successive volumes, finishing in 1905-08. The Transactions section was a set of fully reproduced papers, paginated in Arabic numerals; the Proceedings followed in Roman numerals and covered essentially the same contents as previously. The cumbersome Arabic, Roman alternation was eventually abandoned. The first volume of this new series (1883-1886) included the next paper in the *Fauna of Scotland* series.

A new format and our modern title, the *Glasgow Naturalist* began in 1909 with editors named for the first time: D.A. Boyd and John Paterson. This first volume appeared in four separate parts, each with its own title cover, between November 1908 and September 1909. The contents continued the earlier pattern, essentially, with four named sections: papers, proceedings, excursions and notes. By now, it was common for papers to have citations to other work, as footnotes. Four parts, totalling 153 octavo pages and covering a single year, was no mean feat for a local natural history society. This pattern of publication continued till 1915 (Volume VII). The war years then took their toll. Volume VIII did not appear until 1926 and comprised six parts only, with Proceedings only up to 1918. Volume IX, dated 1919-1930 included only a single part and, for the first time, began with an editorial, explaining the long delay in putting the volume together.

The Publications Committee regarded it as a hopeless task to bring up to date a full account of the Proceedings from 1919 to 1930, so it had been agreed to publish only a "selection of items deemed specially worthy of record". Though much of value had been left out, the editor hoped "that by this violent method the burden of the past will be removed and that the Society can start afresh to publish with proper fullness and regularity". The editorial covered many other points in the Society's recent history: many deaths; more positively, the British Association meeting in Glasgow (1931) in which the Society had been very active (see Richard Weddle's account of the Clyde Lists, Ps. 88-99). The most momentous event covered in the editorial, in terms of Glasgow's natural history societies, was the amalgamation, in 1931, of the Natural History Society of Glasgow with the Andersonian Naturalists and Microscopical Society (see Richard Sutcliffe's history of the Society Ps. 62-7). Volume IX was therefore the last based on the work of the Society as constituted to that time.

The next Volume (X) was published (1932) under the name of the Glasgow and Andersonian Natural History and Microscopical Society. However, the Annals of the Andersonian Naturalists' Society, which had begun in 1893, did not finish until Volume IV in 1936, the final part being a reminiscence of the Andersonians (1885-1930) by John Lee.

During the next 16 years (1931-1946), including the Second World War, 12 parts appeared in 6 volumes, a steady achievement under the circumstances. Thereafter, the journal abandoned Roman numerals and settled to a fairly regular pattern of publishing one part per year, 4-6 parts constituting a volume. The contents were now: papers, a digest of proceedings (highly condensed), notes from excursions and sectional reports. A steady evolution occurred, with society business becoming more abbreviated, and scientific papers taking up more space. A category of short(er) notes appeared from 1963, compiled by Robert Mackechnie till his death in 1978 and thereafter by Alan McG Stirling, 23 years and still going strong. Book reviews appeared from 1980.

Every now and again, there is evidence of the strain that publication of the *Glasgow Naturalist* puts on the Society: this was most obvious in Eric Curtis's Editorial in Volume 19 Part 5 (1978). He began: "The position of the *Glasgow Naturalist* has long been unique in Scotland and many valuable scientific articles covering the full range of Scottish Natural History have been published. Now, however, is the time for taking stock ..." Rising publication costs and a lack of submitted papers were the problems. The membership had to decide whether or not they wished to continue making a long-lasting contribution to Scottish natural history in the form of a proper scientific journal. Whatever the misgivings some members may have had, they were effectively submerged by the very vigorous editorship, over the next two volumes (and 11 years) of Ron Dobson. Ron's meticulousness in checking every detail, even after referees had been satisfied, and his legendary work-rate concealed the real burden that the production of a regular publication represents for a relatively small, unsubsidised, voluntary society. Something had to give, or .... a miracle, which appeared in the entirely unexpected legacy to the Society from the estate of Blodwen Lloyd Binns (BLB), who died in 1991. The Society has used the income accruing from the investment of this legacy in several ways (see Downie, 1998) and immediately, Ron Dobson got agreement that BLB money should allow the journal to print a number of colour pages per issue.

When I took over from Ron as Editor for Volume 23, I made it clear that I could not devote the time Ron had given to physical production and that my office would need some recompense: it was agreed that the BLB would henceworth provide a nominal sum for *Glasgow Naturalist* production, as well as the costs of the colour pages. I also took the opportunity to quiz the membership on what they thought of the journal, and to suggest some changes. The results supported the move from octavo-sized pages to A4, the first page size change in the journal's history. They broadly supported the mainly scientific nature of the contents (by now, the Society also issued a quarterly newsletter with more up-to-the minute information to keep members in touch), but also showed interest in more articles on controversies and historical topics: I hope readers have been satisfied with the moves in these directions, in part by the annual editorial articles.

I doubt that the debate over the production of the *Glasgow Naturalist* has ended, and the new editor (Volume 24) will need to grapple with some real problems. It is anomalous that a local natural history society with a small membership base has managed for so long to produce a high production-standard scientific journal, probably the best of its kind in Scotland. Despite modern computer technology, the costs in time of putting the journal together are very considerable, and not at all reflected in what the Society is currently paying. Yet every now and then, members ask why it is that subscriptions have to rise, despite the existence of the BLB money. The Society's Council has so far taken the view that the BLB fund should be used for scientific natural history work, not to subsidise membership. It may soon have to decide whether this includes paying the real costs of the *Glasgow Naturalist's* publication.

ACKNOWLEDGEMENTS

Thanks to Richard Sutcliffe for his comments on the manuscript and to Jack Gibson for checking details on the 'Missing Proceedings' and the 'Fauna of Scotland'.

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Downie, J.R. (1998) sowing the seed.... the first 5 years of the Blodwen Lloyd Binns Bequest. *Glasgow Naturalist* 23(3), 1-2.

APPENDIX

Extracts and illustrations from *The Proceedings of the Natural History Society of Glasgow* and subsequent titles, with comments in brackets.

Lively Meetings

26/11/1872

"Mr William Johnston exhibited a living specimen of the Four-horned Sheep of St Kilda, a very curious breed, about which little appears to be known."

26/10/1875

"Mr James Lumsden, F.Z.S., exhibited a living specimen of the Osprey *(Pandion haliaetus)*, captured on the 16th of this month on board the S.S. Ethiopia, about 200 miles from the coast of Ireland."

25/1/1876

"Dr Dewar exhibited a pair of live Wild Cats, (*Felis catus,* Linn.), which had been obligingly lent by Mr Henry Martin, Buchanan Street; and remarked that this species was frequently met with in Inverness-shire."

[It was, and still is, the practice of the Society to place on a table unusual and interesting natural history exhibits at ordinary meetings for members to examine. Live material such as potted plants and marine specimens are sometimes exhibited today. Live sheep and live wildcats must have created havoc.]

The Annual Slaughter

30/10/1877

"Note on the recent occurrence of the Hoopoe (*Upupa epops*) in Arran, By Mr James Lumsden, F.Z.S.

On the 23rd May, 1877 a Hoopoe, *Upupa epops*, was shot at Dougrie, Arran. It had been observed for several days frequenting a sand-bank where some starlings had their nests, or running about among the rushes in a marshy field close by. The bird appeared strong on the wing, and was very wild. The gamekeeper who shot it, a man of unusual intelligence, [an obvious requirement for killing birds!] assured me that he thought it had a nest about the sand-bank; but this statement must be taken with considerable reservation."

25/2/1879

"Notes on the occurrence of the Tufted Duck (*Fuligula cristata*) as a breeding species in Scotland. By Mr Rowley Jex Long.

"The specimens which I have brought here tonight, and which were obtained from Perthshire, were sent to me in the latter part of last year, my friend having had them in his possession since last summer. He writes: 'The Tufted Duck's nest I found under a swan's nest, on a small island, about 18 inches down among the straw, and there were 9 eggs in it. I shot the drake, which you have, but the duck got away after being wounded. I took two of the eggs, and went back again a week after, but she never returned so I took the whole of them.'

[During the late ninteenth and early twentieth century the NHSG had two members who were professional Glasgow taxidermists - namely Charles Kirk and Henry McCulloch. Exhibits of stuffed birds or individual skins were therefore commonplace at meetings.]

New Members

27/3/1866

"A proposal of amalgamation, from the members of the Glasgow Naturalists' Society, was submitted to the meeting, and accepted."

30/9/1879

"Towards the close of last Session proposals were made by the Glasgow Society of Field Naturalists for an entrance into this Society, and these being favourably entertained, negotiations were entered upon by the respective Committees, resulting in a satisfactory issue; and at the closing meeting the union was consummated by the entrance of the members of the former Society into the Natural History Society of Glasgow."

The First Exhibition Meeting

24/11/1863

"On Tuesday evening, 24th November 1863, a Conversazione and Exhibition took place in the Queen's Rooms."

Subscription Hike

25/9/1883

"The Treasurer, Mr Robert J. Bennet, submitted his Annual Financial Statement, which showed a balance due to him of £14 0s. 11d. and, with the view of increasing the Society's funds, he recommended that the entry-money should be altered to 7s. 6d., and the annual subscription increased to 7s. 6d."

New Technology

23/6/1885

"An exhibition of microscopic objects later took place, an attractive feature of which was a Lantern Microscope with lime-light, shown by Mr John Trotter. A large number of objects were exhibited, greatly magnified, on a white screen; and the ease with which the minute details of animal and vegetable structures could thus be examined afforded much satisfaction to all present."

[Lime-light was a type of lamp in which lime was heated to white heat using gas burners. Such lamps were often used in stage-lighting - hence the expression 'in the limelight'.]

25/1/1887

"Mr. John Trotter exhibited some improved microscopic apparatus, including a method of illumination by electricity by means of a very small lamp of special construction placed close to the microscope stage, thus obviating the inconvenience of a large battery and the use of condensers." "The small electric lamp could be fitted into any stand without interfering with the use of the ordinary lamp, when its employment might be desired."

4/6/1889

"Mr. C. O. Sonntag read a paper on Mounting Botanical Specimens for the Microscope. These, along with a number of other objects, were afterwards exhibited by means of an oxyhydrogen microscope lent by Messrs. George Mason & Co." [probably an equipment hire company for specialist equipment.]

Weirdo Exhibits

13/8/1889

"Mr. Henry M'Culloch exhibited a Pheasant with four legs." [This was followed by a possible explanation of the abnormality.]

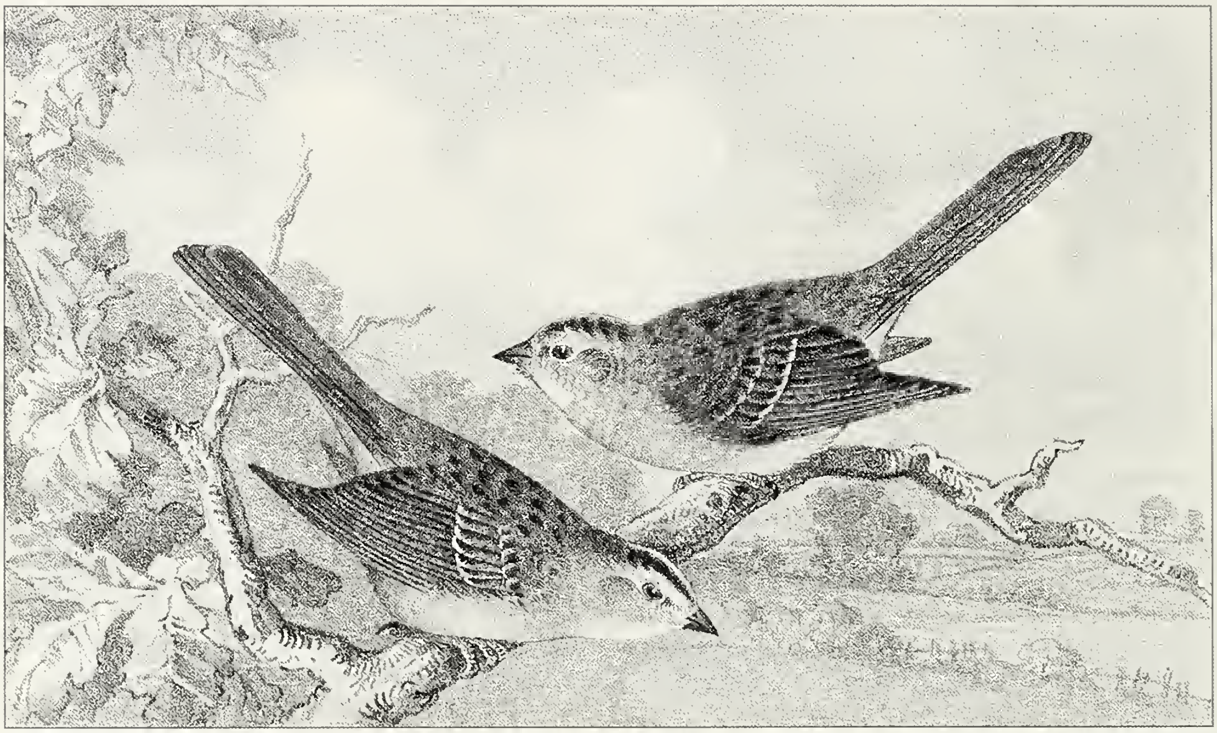
25/3/1890

"Mr. D. A. Boyd exhibited the head of a mummified Cat from Beni-Hasan, Central Egypt."

28/1/1891

"Mr. Robert Broom M.B., C.M., B.Sc., exhibited the head of a cyclopean Lamb, on which he made some remarks."

Trans. Nat Soc Glasgow 1868 Vol I Pl III



W. Sinclair, del. Frank Bott Lith.

WHITE-THROATED SPARROW (Zonotrichia Albicollis)

Notice of the occurence of the White-throated Sparrow (Zonotrichia albicollis) in Aberdeenshire. By Mr W. C. Angus, Aberdeen, Corresponding Member.

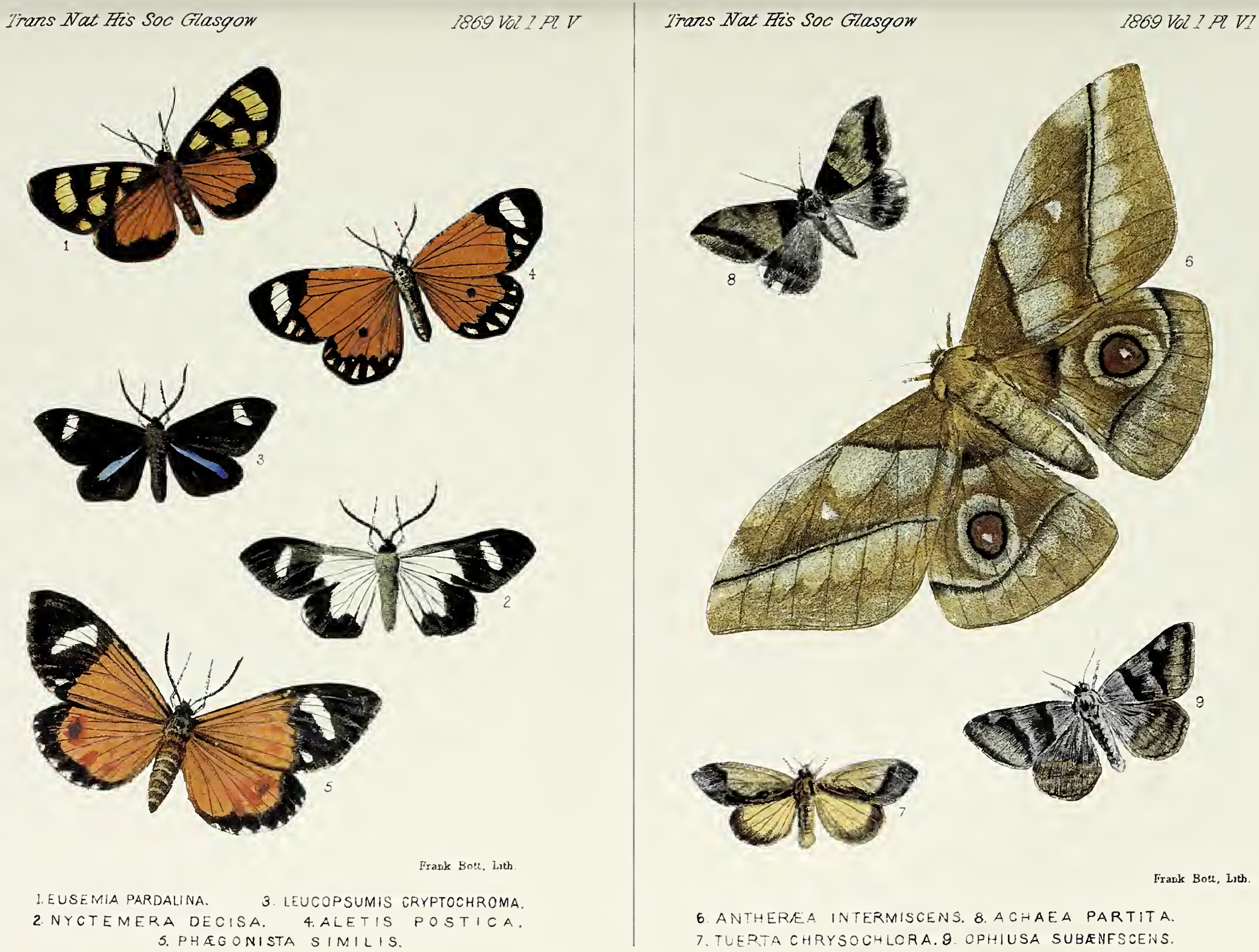
"I have much pleasure in adding this interesting North American species to the fauna of Europe. The bird which I send for exhibition, along with this notice, was shot by Mr Mitchell on the 17th August, 1867, near the Broad Hill, on the Links of Aberdeen. It was put into my hands immediately after being procured, and I made a careful examination of the specimen before it was skinned.-----"

[Detailed description]

"----- I have only to add that the bird bore no traces of having been in confinement, the wings, tail, and all the lower plumage, being quite clean."

"The Plate accompanying this notice is from the pencil of Mr William Sinclair; the upper figure is that of the bird exhibited and the lower one represents a male from the cabinet of Mr E. R. Alston of Glasgow."

Fig. 1 Monochrome Lithograph and text taken from the *Proceedings of the Natural History Society of Glasgow,* 1868



Trans Nat His Soc Glasgow 1869 Vol 1 Pl V

Frank Bott, Lith.

1. EUSEMIA PARDALINA. 3. LEUCOPSUMIS CRYPTOCHROMA.
2. NYCTEMERA DECISA. 4. ALETIS POSTICA.
5. PHÆGONISTA SIMILIS.

Trans Nat His Soc Glasgow 1869 Vol 1 Pl VI

Frank Bott, Lith.

6. ANTHERÆA INTERMISCENS. 8. ACHAEA PARTITA.
7. TUERTA CHRYSOCHLORA. 9. OPHIUSA SUBÆNFSCENS.

Fig. 2 Two of three pages of expensive, chromo-lithographs of foreign Lepidoptera printed in Vol 1 1869 of the *Proceedings and Transactions of the Natural History Society of Glasgow.*

26/4/1892

"Professor Prince exhibited a female Haddock *(Morrhua oeglefinus)* from the East Coast, measuring two feet in length, with a large melanotic tumour."

25/1/1902

"Mr. John Ballantyne exhibited a Chicken with four legs, and made some remarks on its structure."

Stingy Council

28/5/1901

"It was intimated that the Council of the Society had voted a contribution of a guinea towards the maintenance of the Millport Marine Biological Station."

Early Conservation Issues

24/2/1914

"A resolution expressing sympathy with a Bill promoted in Parliament for prohibiting the importation of the plumage of wild birds for millinery purposes, moved by Mr Alex Ross was passed unanimously."

23/12/1924

"A letter was read from Glasgow Corporation in reply to the Society's communication urging the necessity of an Order for the County of the City of Glasgow prohibiting the taking or killing in Glasgow Parks of any wild bird or the taking or destroying of its eggs throughout the whole year. The Corporation, the reply stated, had made application to the Secretary for Scotland for an Order under the Wild Bird Protection Acts, 1880-1908. The application was successful, and such an Order, having this wide scope, covering all species, has been in operation since 1925.

Cause for Concern

25/11/1859

"The subject of the recent mortality among the sea-fowl of the Firth of Clyde having been resumed at this meeting, the following facts were elicited from some of the members present who were involved in its investigation:"

"They were all found much further up the Firth than usual - as if in search of food, many birds being obtained even at Renfrew, and other places, in water at a distance from the sea. In these situations they darted eagerly at any food which came in their way, rushing at baited hooks on a hand-line, and otherwise exhibiting a tameness more like the result of starvation than the effects of disease. They were all in a wasted condition, being almost reduced to skin and feathers, and were found floating in thousands over a wide extent of sea from the mouth of the river Clyde to the Irish coasts."

29/11/1859

"Report on the Mortality amongst the Clyde Sea-Fowl during the month of September last. By Mr David Robertson.

The mortality, not being confined to one species, as is constantly the case in epidemic diseases, and which have been known to occur in other sections of the animal kingdom, the author of the report stated his belief that it was attributable to the extreme scarcity of food, causing an emaciation resulting in death."

[After the First World War, the Natural History Society of Glasgow had lost a number of members due to war casualities. Funds were now lower and the Council decided that the Society Journal, re-named *The Glasgow Naturalist* in 1909, should only contain a Digest of the Proceedings and Transactions of the Society to save space and reduce costs. Accounts of events and speakers were thereafter much less detailed.]

Quality illustrations: a note

In 1868 the NHSG published Vol. 1 of the *Proceedings of the Natural History Society of Glasgow*. This was a major venture by the Society and no expense was spared. The *Proceedings* of 1867-1868 included a number of both colour and black & white lithographs to illustrate some of the published papers. Lithography was a time-consuming and expensive reproduction technique and it is probable that the contributors financed their own illustrations. The less expensive technique of engraving involved the conversion of a pencil drawing or painting into lines cut into a copper plate by an engraver using special tools. Shading and modelling was produced by finer lines or cross-hatching. The success of the finished print depended on the technique and skill of the engraver. Lithography was developed to give a greater likeness to a drawing or painting. This technique involved the use of a block of limestone with the surface ground smooth. Onto this surface a greasy, water-repellent drawing medium was applied onto which the image could be brushed, crayoned or drawn by pen. The surface was then dampened and an oil-based ink applied. A new stone or plate was needed for each area of the image to be printed in a separate colour.

Vol. 1 of the *Proceedings* included four excellent black and white lithographs. The first was a plate of paleozoic fossils by Prof. J. Young; the second was an unusual illustration of dredging apparatus used by Mr. David Robertson, the third a charming image of two white throated sparrows (Fig. 1) and finally a plate illustrating carboniferous fossils by Mr. John Young. The most impressive illustrations were three pages of coloured lithographs of lepidoptera illustrating a paper entitled *On some Lepidopterous Insects from Congo* by Mr. Thomas Chapman (Fig. 2). These were the only coloured illustrations published in all of the following volumes of the *Proceedings* and the later *Glasgow Naturalist* until the inclusion of colour plates in Volume 22, part 4 in 1994.

GLASGOW NATURALIST Vol. 23 Part 6 pp 74-79 (2001)

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF GLASGOW: THE MISSING YEARS, 1851 TO 1859

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INTRODUCTION

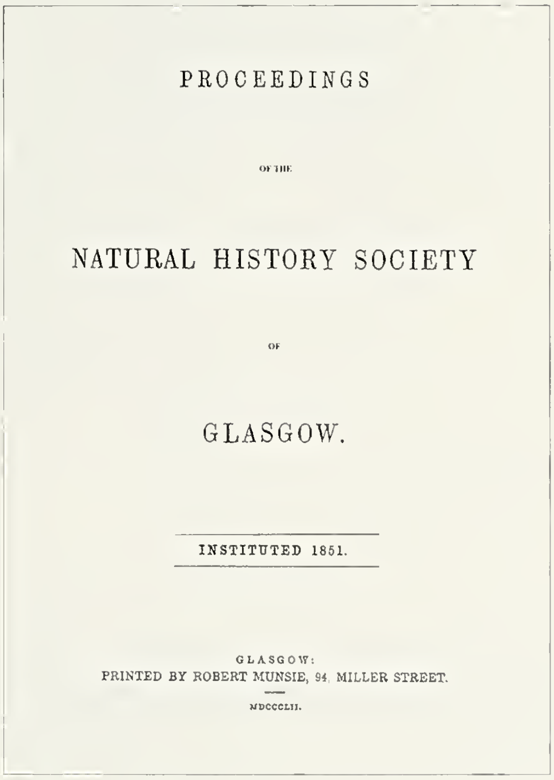
The Natural History Society of Glasgow was instituted on 2nd July 1851, and seventeen years later, in October 1868, it published the first part of what was described at the time as Volume One of its *Proceedings*, covering the activities of the Society from its eighth Annual General Meeting on 27th September 1859. This volume number, however, was an error, since the Society had already published a previous volume of *Proceedings* in 1852 and, in addition, quite contrary to what members might have assumed from a short prefatory Note to the 1868 volume, regular accounts of the Society's activities during its earliest years, plus several important papers read to the Society, had previously been published in Morris's *Naturalist* from 1851 to 1857, some of the early 'missing years'.

The 1852 volume of *Proceedings* was later reprinted by the Scottish Natural History Library, as part of its series of reissued scarce or unusual Scottish natural history items, and at several Scottish meetings of the Society for the Bibliography of Natural History I have previously drawn attention to the existence of these early historical records of the Glasgow Society in Morris's *Naturalist*, but have not so far published the information, so the 150th anniversary of the founding of our Society seems to be the ideal time to set the record straight.

THE PROCEEDINGS OF 1852 AND 1868

In 1852 the Society issued its first publication, a booklet containing sixteen pages, trimmed to $8^{1}/_{2}$ by $5^{1}/_{2}$ inches, in blank pink-paper covers, entitled *Proceedings of the Natural History Society of Glasgow* (see Figure 1), detailing the activities of the Society during the first six months of its existence, from July to December 1851. In the 1868 Note these *Proceedings* were called a "fasciculus".

For the next sixteen years the Society itself published nothing more, but in October 1868 it issued Volume One, Part One of a new publication, again entitled *Proceedings of the Natural History Society of Glasgow,* with printed buff-board covers showing the Society's Glasgow crest, and measuring some $8^{3}/_{4}$ by $5^{3}/_{4}$ inches untrimmed, the standard format maintained over the following years.



PROCEEDINGS

OF THE

NATURAL HISTORY SOCIETY

OF

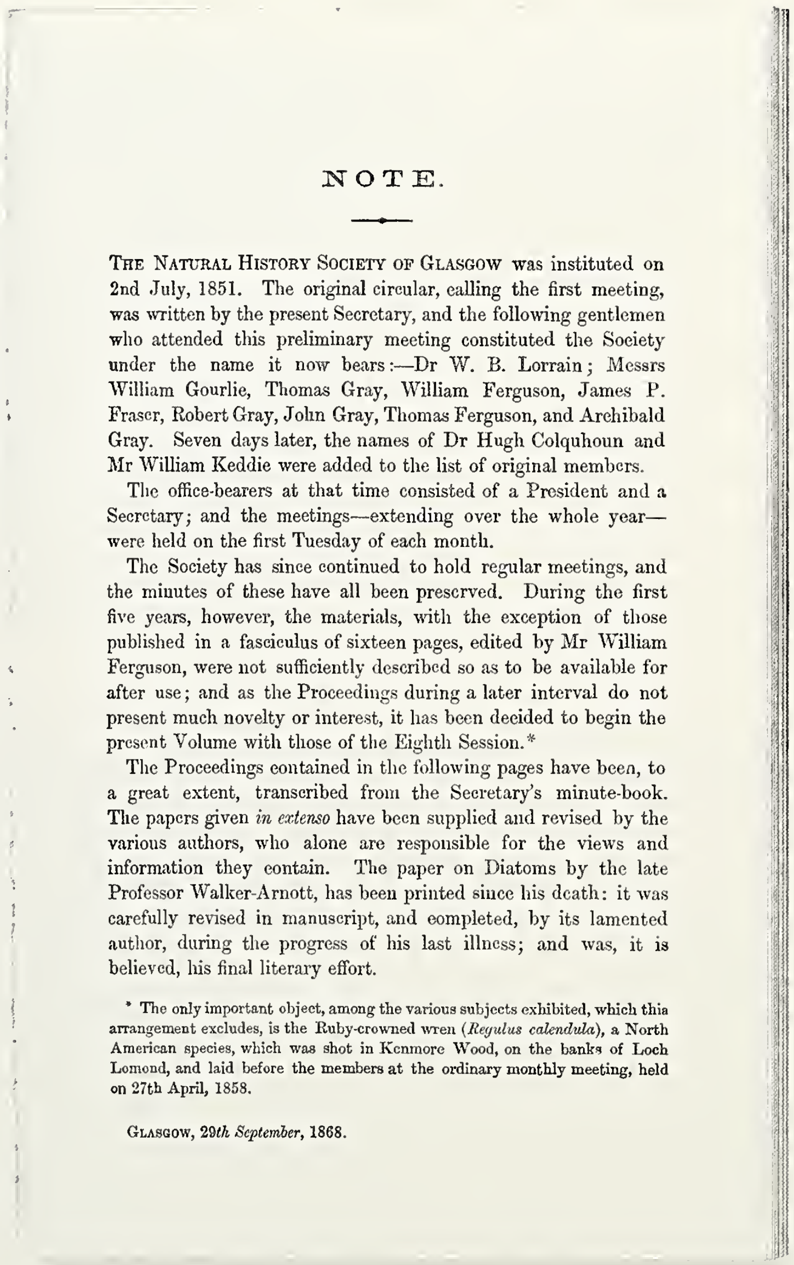
GLASGOW.

INSTITUTED 1851.

GLASGOW:
PRINTED BY ROBERT MUNSIE, 94, MILLER STREET.
MDCCCLII.

Fig. 1. Title-page of the first volume of *Proceedings* (1852).

It was most unfortunate that the first volume of these new *Proceedings* was entitled Volume One, which was clearly incorrect, when some alternative numbering, such as Volume Two or Volume One (new series) could easily have been used and would have been much more appropriate. These new *Proceedings* published in 1868 summarised the activities of the Society from the commencement "of the Eight Session" on 27th September 1859, but unfortunately contained no record of the earlier activities of the Society, before 1859. To be quite fair, at the start of Volume One, Part One there was a preliminary one-page Note, unsigned, dated 29th September 1868 (the date of the seventeenth Annual General Meeting), which



NOTE.

The Natural History Society of Glasgow was instituted on 2nd July, 1851. The original circular, calling the first meeting, was written by the present Secretary, and the following gentlemen who attended this preliminary meeting constituted the Society under the name it now bears:—Dr W. B. Lorrain; Messrs William Gourlie, Thomas Gray, William Ferguson, James P. Fraser, Robert Gray, John Gray, Thomas Ferguson, and Archibald Gray. Seven days later, the names of Dr Hugh Colquhoun and Mr William Keddie were added to the list of original members.

The office-bearers at that time consisted of a President and a Secretary; and the meetings—extending over the whole year—were held on the first Tuesday of each month.

The Society has since continued to hold regular meetings, and the minutes of these have all been preserved. During the first five years, however, the materials, with the exception of those published in a fasciculus of sixteen pages, edited by Mr William Ferguson, were not sufficiently described so as to be available for after use; and as the Proceedings during a later interval do not present much novelty or interest, it has been decided to begin the present Volume with those of the Eighth Session.*

The Proceedings contained in the following pages have been, to a great extent, transcribed from the Secretary's minute-book. The papers given *in extenso* have been supplied and revised by the various authors, who alone are responsible for the views and information they contain. The paper on Diatoms by the late Professor Walker-Arnott, has been printed since his death: it was carefully revised in manuscript, and completed, by its lamented author, during the progress of his last illness; and was, it is believed, his final literary effort.

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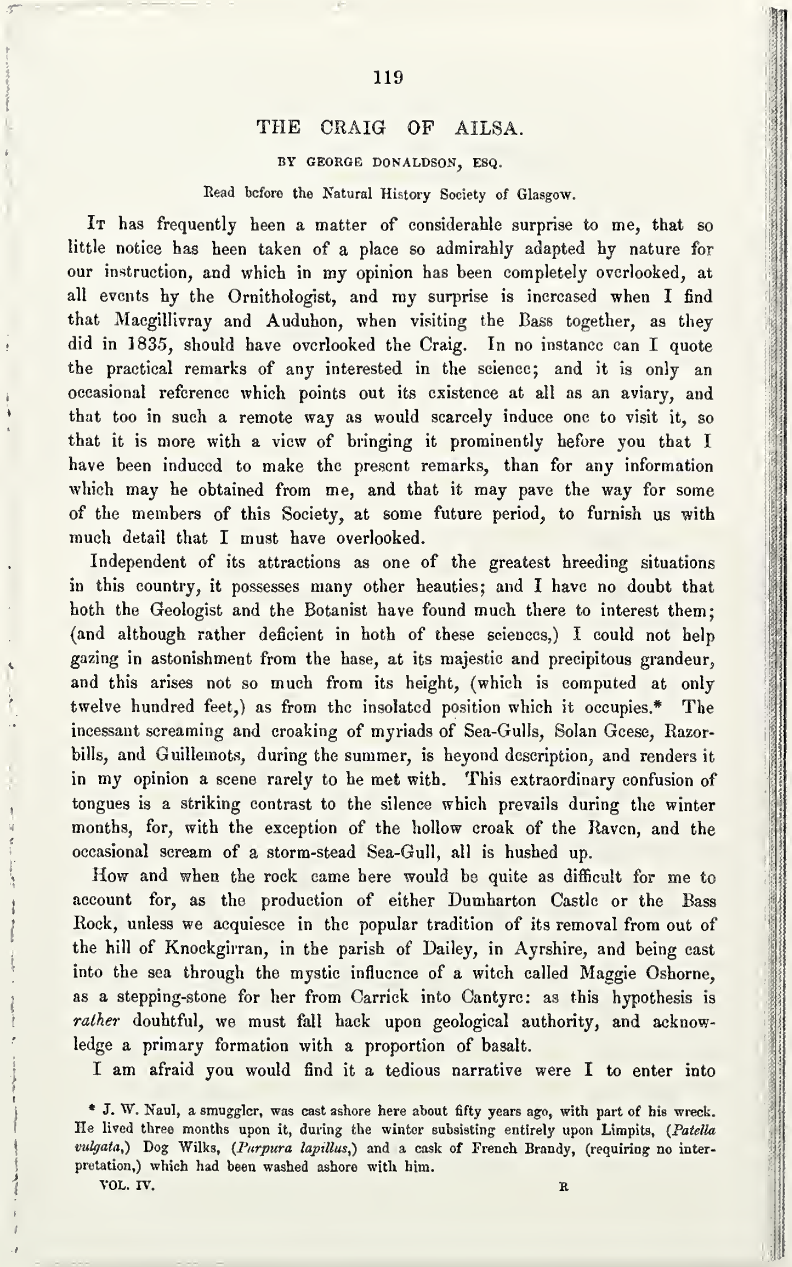
* The only important object, among the various subjects exhibited, which this arrangement excludes, is the Ruby-crowned wren (*Regulus calendula*), a North American species, which was shot in Kenmore Wood, on the banks of Loch Lomond, and laid before the members at the ordinary monthly meeting, held on 27th April, 1858.

Glasgow, 29*th September*, 1868.

Fig. 2 The 1868 Note



THE CRAIG OF AILSA.

BY GEORGE DONALDSON, ESQ.

Read before the Natural History Society of Glasgow.

It has frequently been a matter of considerable surprise to me, that so little notice has been taken of a place so admirably adapted by nature for our instruction, and which in my opinion has been completely overlooked, at all events by the Ornithologist, and my surprise is increased when I find that Macgillivray and Audubon, when visiting the Bass together, as they did in 1835, should have overlooked the Craig. In no instance can I quote the practical remarks of any interested in the science; and it is only an occasional reference which points out its existence at all as an aviary, and that too in such a remote way as would scarcely induce one to visit it, so that it is more with a view of bringing it prominently before you that I have been induced to make the present remarks, than for any information which may be obtained from me, and that it may pave the way for some of the members of this Society, at some future period, to furnish us with much detail that I must have overlooked.

Independent of its attractions as one of the greatest breeding situations in this country, it possesses many other beauties; and I have no doubt that both the Geologist and the Botanist have found much there to interest them; (and although rather deficient in both of these sciences,) I could not help gazing in astonishment from the base, at its majestic and precipitous grandeur, and this arises not so much from its height, (which is computed at only twelve hundred feet,) as from the insolated position which it occupies.* The incessant screaming and croaking of myriads of Sea-Gulls, Solan Geese, Razor-bills, and Guillemots, during the summer, is beyond description, and renders it in my opinion a scene rarely to be met with. This extraordinary confusion of tongues is a striking contrast to the silence which prevails during the winter months, for, with the exception of the hollow croak of the Raven, and the occasional scream of a storm-stead Sea-Gull, all is hushed up.

How and when the rock came here would be quite as difficult for me to account for, as the production of either Dumbarton Castle or the Bass Rock, unless we acquiesce in the popular tradition of its removal from out of the hill of Knockgirran, in the parish of Dailey, in Ayrshire, and being cast into the sea through the mystic influence of a witch called Maggie Osborne, as a stepping-stone for her from Carrick into Cantyre: as this hypothesis is *rather* doubtful, we must fall back upon geological authority, and acknowledge a primary formation with a proportion of basalt.

I am afraid you would find it a tedious narrative were I to enter into

---

* J. W. Naul, a smuggler, was cast ashore here about fifty years ago, with part of his wreck. He lived three months upon it, during the winter subsisting entirely upon Limpits, (*Patella vulgata*,) Dog Wilks, (*Purpura lapillus*,) and a cask of French Brandy, (requiring no interpretation,) which had been washed ashore with him.

Fig. 3 First page of a paper read to the Society and published in Morris's *Naturalist*

attempted to explain the omission (see Figure 2). This preliminary Note, however, was seriously flawed in several important respects.

THE 1868 NOTE

Firstly, no proper attention was drawn to the existence of this Note, indeed one could easily think that its very existence was almost concealed, since most surprisingly it was omitted from the List of Contents issued with Volume One, Part One (1868), nor was it included in the complete List of Contents for Volume One, later issued with the second part of Volume Two in 1876.

Since there was no mention of the Note in the List of Contents, this page was frequently discarded, along with the covers (a common practice of the time), by subsequent binders, so that many bound volumes of the Society's *Proceedings* do not include this Note, with the result that some later researchers could easily be deceived into believing that no earlier *Proceedings* or other publications existed. Fortunately, this preliminary Note is present in the bound volumes possessed by most of the major national collections, plus the Society's own library, but these are in the minority and the Note has been missing from over twenty bound volumes of the Society's *Proceedings* which I have managed to examine during the past fifty years; no doubt there are many more.

Secondly, nowhere in the Note is there any indication at all that the sixteen-page publication of 1852, called a "fasciculus", was actually the first volume of the Society's *Proceedings*, and bears the title-page *Proceedings of the Natural History Society of Glasgow* (Figure 1). This is a serious and highly misleading omission, and future generations of Society members, even if they were so fortunate as to be consulting a bound volume which did actually include the Note, could be forgiven for assuming that this fasciculus was simply one of several ephemera issued by the Society, such as notices, newsletters &c, and not genuine *Proceedings*.

There is a further interesting point. These first *Proceedings* were not included in the list of the Society's publications which were regularly advertised, with prices, on the back covers of each succeeding part of the later *Proceedings*. This could not have been just because the first *Proceedings* were out of print, since other parts of the later *Proceedings* were listed even although they were also described as being 'out-of-print'. The first *Proceedings* were simply omitted; it is almost as though their existence was being concealed.

Very much later, when the cumulative Index to the *Proceedings* was published (in 1885), the Index was entitled 'Vols. 1 to V. – 1851-1883', so the existence of the earlier *Proceedings* was now acknowledged by date, and the start of the general section of the Index also included the following preliminary announcement: "When the number of the volume is not given, the reference is to the First Part of the *Proceedings*, which is not included in vol. i". It would appear, therefore, that some belated attempt was being made to correct the earlier mistaken position, even although the volume numbers and dates on the Index title-page could have been more accurately described.

TABLE 1

Proceedings of the Natural History Society of Glasgow

Published in the *The Naturalist* (Morris's), Vols. 2(1852) - 5(1855)

	Date of Meeting	Reference
Vol. 2:		
	02.07.51	2: 23
	09.07.51*	2: 23
	05.08.51*	2: 23-24
	07.10.51	2: 39
	04.11.51	2: 39-40
	02.12.51*	2: 40
	06.01.52*	2: 87-88
	03.02.52	2: 112
	02.03.52	2: 112
	06.04.52*	2: 183-184
Vol. 3:		
	05.10.52*	3: 23-24
	02.11.52*	3: 38-39
Vol. 4:		
	06.12.53	4: 46
	07.02.54*	4: 92-93
Vol. 5		
	04.07.54	5: 17
	01.08.54*	5: 17-19
	05.09.54*	5: 19-20
	03.10.54*	5: 20-21, 41-43
	07.11.54*	5: 43-45

*Meetings reported in some detail

Even more unfortunately, however, the 1868 Note was categorically wrong when it stated "During the first five years [1851-1855] ... the materials .... were not sufficiently described so as to be available for after use; and ... the Proceedings during a later interval do not present much novelty or interest". This is completely untrue, and the reason for this wholly inaccurate statement is a considerable mystery. It would have been just as easy to write a short paragraph outlining the true position.

In actual fact, many of the early Proceedings of the Society from its foundation in July 1851 had already been published in contemporary parts of Morris's *Naturalist* from Volume 2 (1852) to Volume 5 (1855); these included several substantial items reported in some detail, and also several important papers, up to 1857, subtitled 'Read before the Natural History Society of Glasgow' and printed *in extenso* (e.g. Figure 3). A

TABLE 2

Published Papers, 1851 to 1859

Subtitled 'Read before the Natural History Society of Glasgow'

Scouler, John (1851)

Of the occurrence of the remains of the Reindeer in Scotland.
Edinburgh New Philosophical Journal **52**, 135-137.

Fraser, James P. (1852)

Notes illustrative of the geology of part of the shores of East Lothian and Berwickshire.
Naturalist (Morris's) **2**, 173-177, 195-200.

Donaldson, George (1854)

The Craig of Ailsa.
Naturalist (Morris's) **4**, 119-125.

Donaldson, George (1854)

The arrival, nestling, habits, and departure of the sea-fowl at the Craig of Ailsa.
Naturalist (Morris's) **4**: 125-127.

Gray, Robert (1857)

Remarks upon the Ringed Guillemot.
Naturalist (Morris's) **7**, 166-171.

list of the Society meetings reported in Morris's *Naturalist* is given in Table 1. Table 2 lists the papers marked as read to the Society and published *in extenso* in Morris's *Naturalist* and elsewhere.

In the 1868 Note there is no indication that all this early published material exists, indeed its existence is apparently denied, and possible reasons for this omission are discussed later.

MORRIS'S NATURALIST

Morris's *Naturalist* was a highly regarded journal of its day, which published many important and often pioneer scientific papers. Edited from 1851 to 1858, firstly by Dr. B.R. Morris (who was elected a Corresponding Member of the Natural History Society of Glasgow on 2nd March 1852) and then by the Rev. F.O. Morris, and nowadays usually referred to as the *Naturalist* (Morris's), it was part of a nearly continuous series of journals called *The Naturalist*, with an earlier series from 1837 to 1839 (usually called Wood's) and later continued from the 1860s to the present day.

Many prominent members of the Natural History Society of Glasgow published the results of their researches in its pages, both before and after the formation of the Glasgow Society, and at least four major papers published from 1852 to 1857 (i.e. years during which the Glasgow Society was not publishing its own *Proceedings*) were subtitled 'Read before the Natural History Society of Glasgow'; one of these papers was by the Society's Secretary, Robert Gray, who also contributed several other important papers, not marked as read to the Society. The journal also had a regular section called 'Proceedings of Societies' which published accounts of the meetings of many scientific societies, both local and national, so it was perfectly natural that the new Natural History Society of Glasgow should have its activities included.

The only mystery is why all this easily accessible source of early Society history was not later reported to the Society's members; it would have been so easy to insert an appropriate explanatory paragraph into the 1868 Note. Possibly the 1868 Note's most serious omission, however, was its complete failure to make any mention of Professor John Scouler, the Society's original Honorary President.

PROFESSOR JOHN SCOULER

The fact that many of the early Proceedings of the Society were never published, or were overlooked, plus subsequent faulty reporting, has been less than kind to the memory and reputation of Professor John Scouler (Fig. 4), the Society's first Honorary President. Professor Scouler, born in Glasgow and Professor of Natural History at Glasgow's Andersonian University from 1829 to 1833, was a distinguished natural historian of his day who, at the time of the formation of the Glasgow Society in 1851, was currently Professor of Natural History at the Royal Society of Dublin. During his time in Dublin, however, he regularly travelled back to Glasgow, and again became resident in Glasgow from 1853, when he retired from his Dublin professorship on grounds of increasingly failing health.

At a "preliminary meeting" on 2nd July 1851 nine men met and agreed to form a society, "under the name of the Natural History Society of Glasgow", as later correctly detailed in the 1868 Note. Mr. William Gourlay was elected President, and Mr. James P. Fraser was elected Secretary and Treasurer. One week later, at the second meeting (called an "extraordinary meeting") on 9th July, Professor John Scouler read the first-ever paper delivered to the Society, entitled 'On the Symmetry of Plants and Animals', and immediately afterwards it was "proposed that Dr. Scouler be elected Honorary President of the Society, which was carried by acclamation". This was followed by the election of two other "Original Members".

All this was correctly reported both in the relevant section of Morris's *Naturalist* and later in the Society's own 1852 volume of *Proceedings*. Examination of those accounts of the Society's later meetings which did actually appear in print, up to

Fig. 4 Professor John Scouler, portrait reproduced from the *History of the Geological Society of Glasgow* (1908), by MacNair, P. and Mort, F.

the end of 1854 in Morris's *Naturalist*, show that Professor Scouler was no mere figure-head. With his reputation, regular attendance at meetings, and his several important scientific papers, either directly read or otherwise communicated, he probably played a greater part than anyone else in the early development of the Society, and well merited his appointment as Honorary President, by which title he was always referred to in reports of the Society's meetings. He continued to play a very active part in all the Society's activities, seldom missing a meeting, until 1866.

Despite all this, nowhere in the 1868 Note, which attempted to describe the formation of the Society in 1851 by giving a list of the "Original Members", is there even a mention of Professor Scouler, an omission which seems both inexcusable and nearly inexplicable. There may, however, be a possible explanation. In its early days the Society, apart from its Honorary Members, classed its members as 'resident', those actually living within the city of Glasgow or nearby, and 'corresponding', those living much further away, and the later anonymous, and apparently inadequately informed, writer of the 1868 Note may have mistakenly restricted the list of "Original Members" to those who were 'resident', thereby overlooking the Society's only Honorary and most distinguished member.

By the time of the eighth Annual General Meeting, held on 27th September 1859, which was the first meeting reported in the Society's 1868 *Proceedings*, we find Professor Scouler recorded not as Honorary President, but as President of the Society. The year when he became President is not stated, and presumably can now only be established by referring to the Society's Minutes, should these exist in sufficient detail. It should be noted that, during this time, Professor Scouler also held office as President (1859-62) of the Geological Society of Glasgow. Professor Scouler served as President of the Natural History Society until the fifteenth Annual General Meeting on 25th September 1866 when he retired, being succeeded as President by Dr. Hugh Colquhoun. He continued as a Member of Council, but for only one more year, presumably because of his steadily deteriorating health.

At some time, therefore, between 1851 when he was elected Honorary President, and 1859 when he was shown as President, Professor Scouler apparently changed from being Honorary President to President. So what is the explanation? Did he hold both offices at the same time, did he temporarily relinquish the position of Honorary President when he became President, and after he retired as President did he again become Honorary President? Was the office of Honorary President eventually abolished, or did it simply fall into disuse after Professor Scouler's death because there was no other suitable candidate? As far as can be ascertained from the published *Proceedings*, the Society never again had an Honorary President. This distinctly blurred part of the Society's early history has always considerably perplexed me, and just after the centenary celebrations, in an attempt to clear up the matter, I asked to see the Society's early Minutes, where the correct information would presumably be recorded, but despite several requests, the Minutes could not be produced.

Professor Scouler died in 1871, and in a brief and somewhat inadequate death notice (*Proceedings*, 2: 175; 1876), he was certainly referred to as the first Honorary President of the Society, although the year of his election was incorrectly given as 1853, a date not subsequently corrected in the later more generous account of his life (*Glasgow Naturalist*, 18: 210-212; 1962). This makes me wonder whether the relevant Minutes, which could not be produced in 1951, were also missing in 1871, so that, when the time came to write Professor Scouler's death notice, the Society did not have the benefit of any written record. In the 1868 Note the Society's early Minutes were said to have "all been preserved" but "were not sufficiently described so as to be available for after use", which seems very suspicious. Missing or inadequate Minutes, and having to rely on a faulty memory, especially since most of the original members were no longer available, might also account for the many inaccuracies in the 1868 Note.

With the Society now reaching its 150th anniversary, however, a serious search should be made in an attempt to discover the whereabouts of the first eight years' Minutes, in the hope that this early history of the Society can at long last be properly recorded.

DISCUSSION

It is very difficult to understand why these fairly extensive, and often important, published Society activities were not reported, or at least some indication given that they actually existed, rather than their existence being apparently obscured. Quite apart from the papers separately published *in extenso*, the Society meetings reported in Morris's *Naturalist* contained significant printed contributions by many prominent members of the Society, including George Donaldson, Thomas Ferguson, William Ferguson, James P. Fraser, John Gray, Robert Gray, Roger Hennedy, William B. Lorrain, and John Scouler, plus an extended obituary of the Rev. Dr. David Landsborough. This is all important material, and members should certainly have been told that it existed.

Reports of the Society's meetings during the first six months of its existence, from July to December 1851, appeared in both the Society's own first *Proceedings* and in the 'Proceedings of Societies' section of Morris's *Naturalist*, and if we compare these two sets of reports it can be seen that they are extremely similar, with the accounts of some meetings identical word for word. Moreover, the later Society reports in Morris's *Naturalist* are presented in almost precisely the same style as the meetings reported from 1859 onwards in the Society's own later *Proceedings*, so with this (plus Dr. Beverley R. Morris's close connection with the Glasgow Society, noted earlier) there seems little doubt that these were all official communications provided to Morris's *Naturalist* by the Society. Steps were also taken to subtitle some major papers as 'Read before the Natural History Society of Glasgow'. Clearly in the 1850s the newly-formed Glasgow Society was obviously trying to get as much publicity as possible, and rightly so. So why later attempt to indicate in the 1868 Note that there was little of interest during the 1850s, which was manifestly untrue? Why not draw proper attention to all the accounts of meetings and major papers previously published elsewhere under the Society's name? This is the real problem.

Although announcements such as the 1868 Note would usually have been written by the Society's current Secretary, at that time the distinguished Robert Gray, it is very difficult to believe that Gray, the most meticulous of recorders, would ever have permitted such ambiguous, or plainly incorrect, statements to appear. Some other explanation is required, and although several suggest themselves, only one seems reasonably likely.

Possibly the simplest explanation for the confusion is that the 1868 Note was very much a last-minute addition, put together in something of a hurry when it was realised, rather late in the day, that the Society had to give some kind of explanation for restarting publication in 1868, but with no reports of its meetings from 1851 to 1859. A last-minute additional preliminary page, not numbered, might also explain why it was too late to include the Note in the presumably already-printed List of Contents.

Possibly the anonymous official of the Society who had to produce the 1868 Note for the printer in a great hurry was insuffcently informed about the Society's early history, and was genuinely unaware that all these earlier *Proceedings* of the Society had already appeared in print; 1868, of course, was some twelve to sixteen years after the events. Possibly there was no opportunity or time to consult senior and more knowledgeable members of the Society, or possibly he simply did not appreciate that this was necessary. It should be realised that at the time of the Annual General Meeting of 1868 only two of the fourteen Office-Bearers and Members of Council were original members of the Society, so it is perfectly possible that knowledge of the early years of the Society was not widespread. There is also the likelihood that the relevant Minutes were either missing or "not sufficiently described".

It is certainly something of a mystery, which we are now never likely to solve, but there is no doubt that these published materials remain an important part of the Society's early history and their existence should finally be placed on record.

SUMMARY

In its sections on 'Proceedings of Societies', Morris's *Naturalist* published accounts of nineteen meetings of the Natural History Society of Glasgow; accounts of the first six of these meetings, from July to December 1851, were also published by the Society in its first volume of *Proceedings* (1852). The remaining thirteen meetings extended over the next three years to the end of 1854, and at least nine meetings were reported in considerable detail, some containing material certainly as contemporarily important as other matters reported in the Glasgow Society's own published *Proceedings*, earlier or later. In addition, several papers, subtitled 'Read before the Natural History Society of Glasgow', were published *in extenso*, up to 1857. The reason why this earlier published material was not drawn to the attention of members is not known.

It may be that some Proceedings of the Society also appeared in other journals but, if so, I have not yet come across them despite extensive searches, and shall be grateful to have any additional items drawn to my attention.

GLASGOW NATURALIST Vol. 23 Part 6 pp 80-87 (2001)

PHOTOGRAPHY IN THE GLASGOW NATURAL HISTORY SOCIETY

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INTRODUCTION

When the nine 'Gentlemen interested in the pursuit of Natural Science' met in Glasgow in 1851 to form the Natural History Society of Glasgow (NHSG), the new science of photographic imaging was only about ten years old. The photographic processes in use were expensive, time-consuming and highly skilled - even hazardous. Photographers had to prepare their own light sensitive emulsions in a darkroom, coat the emulsion onto paper, metal or glass, and expose the material wet in the camera. These plates had then to be processed immediately after exposure. The procedures were feasible in the convenience of a photographic portrait studio but photography in the field involved travelling about with a portable darkroom built into a horse-drawn wagon. Some early photographers were so dedicated to their art that they managed to undertake excellent photography during the 1850s while abroad in the heat and sands of Egypt, in India, in the Far East and even in the aftermath of battles during the Crimean War.

In the 1880s the advent of prepackaged, commercially available, dry glass-plates released photographers from the restriction of having to be near a darkroom facility. The exposed dry plates could be stored and processed later at a more convenient time. Wildlife photography in the field now became more practicable. Pictures could be taken by waiting in a hide with everything set up ready for a good opportunity to arise. During the following decades the clicking of Society members' cameras could be heard in many remote corners of Scotland. The wildlife photography of these pioneering NHSG members became well-known throughout Scotland and even nationally. In 1869 the NHSG published volume one of *The Proceedings of the Natural History Society of Glasgow* covering the period from 1859-1869 in which full details of meetings, lectures, exhibits and membership lists were given. The following information has been extracted from the *Proceedings* and subsequent titles.

EARLY PHOTOGRAPHY

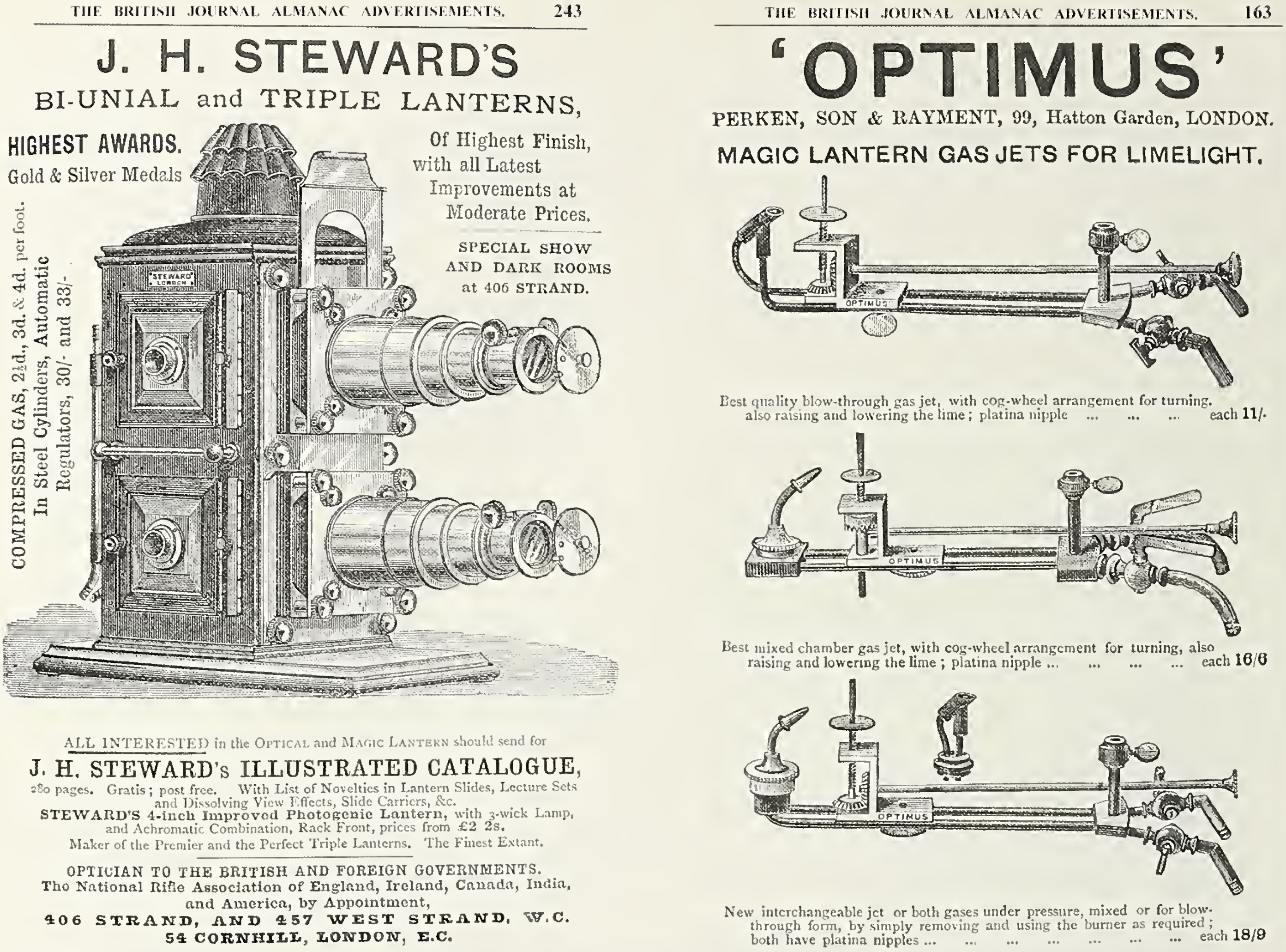
There is no mention of photographs in the accounts until the 18th October 1869. The *Proceedings* record that Mr Gray "also submitted to the inspection of the meeting a photograph of Urns and Bones, lately taken from several graves of ancient Britons discovered in Cumbrae, and read a short notice of them, sent by Mr John Levack, a corresponding member."

The next reference to photographs was in 21st February 1871 when "Mr John Young, F.G.S., exhibited photographs of ripple-marked sandstone, and unusually large stems of *Lepidodrendon* and *Sigillaria,* which had been taken from the adjoining quarries during the progress of building of the new University." It is not recorded who took the pictures therefore it is unlikely that it was a member of the NHSG.

On the 31st March 1874 it is noted that a Glasgow photographer was commissioned to produce the following pictures. "A number of large and beautiful photographs of slabs of polyzoa, crinoidea, and shells, executed by Mr Thomas Annan, Sauchiehall Street were exhibited by the President (Professor John Young, M.D., F.G.S.) as illustrative of what could be done by photography in producing faithful pictures of the numerous and varied organisms that crowd many of our limestone shales." Thereafter photographs were displayed regularly.

On the 29th November 1886 "Mr. James J. F. X. King, on behalf of the donors, presented to the Society a framed photograph of the party present at the excursion to Cadzow Forest [Hamilton High Parks] on the 25th September. The print, which was a fine example of photographic art, had been produced on a much enlarged scale by Mr William Goodwin; and an elegant frame provided by Mr W. Craibe Angus, added considerably to the attractiveness of its appearance." Mr William Goodwin, elected a member in 1881, was probably the Society's first member who practiced photography. In 1883 he was noted as having given a demonstration of photography using a microscope.

As the years passed more and more Society members emerged from darkrooms across Glasgow producing exciting images of natural history subjects. The Council at a meeting on the 28th October 1890 issued the following notice "regarding the more efficient working of the various departments of the Society's business" suggesting that the Society should "provide *inter*



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both have platina nipples ... ... each 18/9

Fig. 1 An advert for a Magic Lantern and ancillary apparatus taken from the *British Journal of Photography Almanac*

alia for the appointment annually in November of the following Committees to undertake certain specified duties: (1) Museum Committee, (2) Research Committee, (3) Summer Committee, (4) Publishing Committee, (5) Library Committee, (6) **Photographical Committee,** and (7) Microscopical Committee." This is the first mention of a Photographic Section. Unfortunately, the list of office-bearers for that and subsequent years, does not formally include the Convenors of Sections who were *ex officio* members of the Council.

THE MAGIC LANTERN

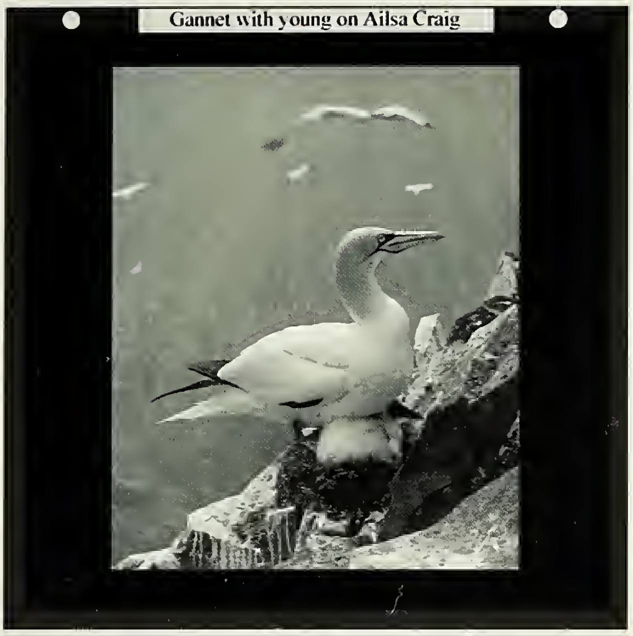
In the 1880s mention is made of Lantern Slide shows. The first recorded was a presentation given by Mr Thomas King. He "made some remarks on the use of the Magic Lantern (Fig. 1) for the purposes of teaching" and "in illustration of his remarks, Mr King exhibited a series of lantern-slides representing groups of the *Diatomaceae*, sections of tissues, etc., and, in every case the minute details of the objects were brought out with a very clear definition."

In the 1890s lectures were often described as being illustrated by 'Lime-light Views'. This description resulted from the method used to produce a bright light in the Lantern or projector in today's terminology. Before the advent of convenient supplies of high voltage electricity, the most popular way to illuminate a projector was to burn a piece of lime to white-heat by using gasburners. A supply of compressed gas was available in cylinders from the manufacturers of the equipment. Such projectors must have been rather noisy, certainly rather smelly and obviously highly dangerous!

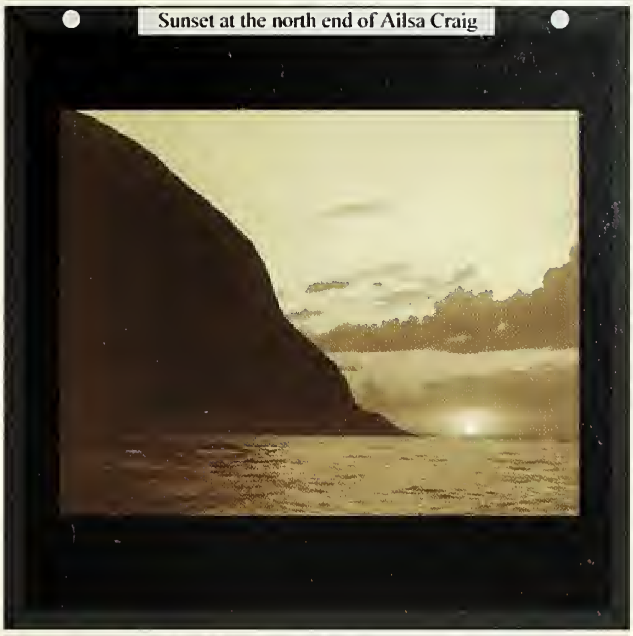
As the popularity and frequency of Lantern Shows increased, the Council called in 1900 for voluntary contributions towards the purchase of "a Lime Light Lantern and it was intimated that the fund had reached £22." An Honorary Lanternist was appointed later. As far as is known, he survived the experience!

The Magic Lantern itself projected a 3_ square inch slide onto a white wall or cloth. Some Lanterns had two or even three lenses and this allowed dissolves between the pictures including superimpositions. The effects produced by these arrangements were often dramatic and spectacular - hence the popular name of Magic Lantern. Lantern slides were mainly black and white but many artistic workers chemically toned their slides for effect (Fig. 2). Others hand-tinted the black and white slides in natural colours using dyes. Some remarkably beautiful slides were produced.

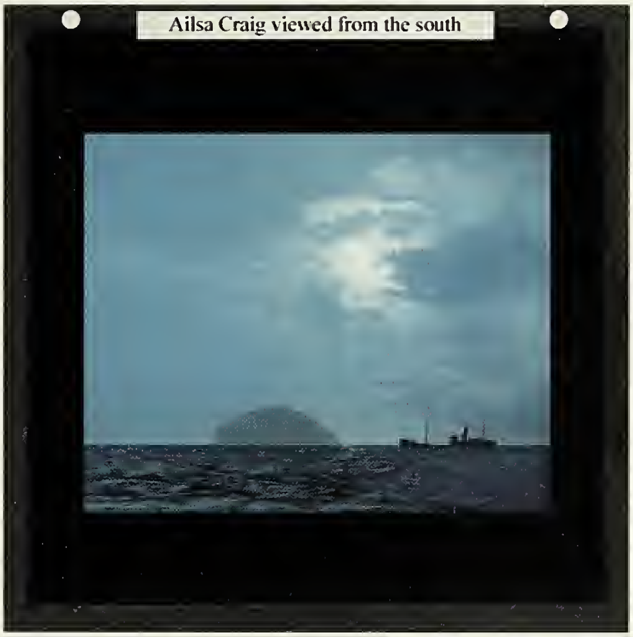
Fig. 2 Lantern Slides used by members of the Society between c1900 to the 1950s.



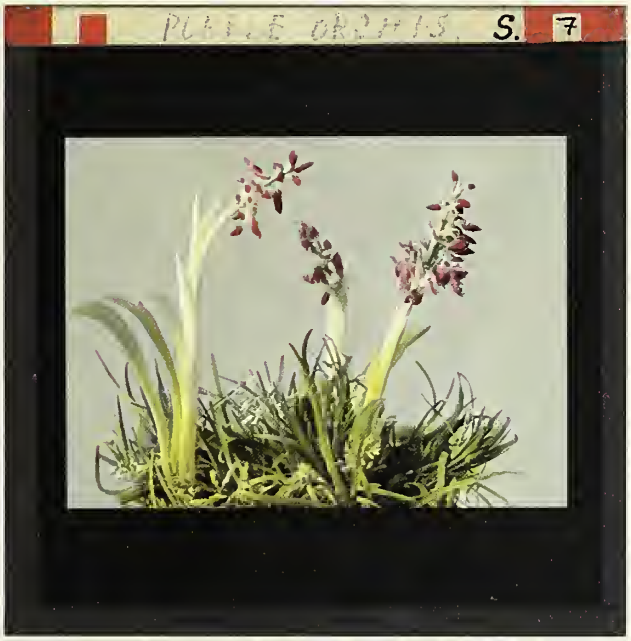
Standard black & white slide - Charles Kirk



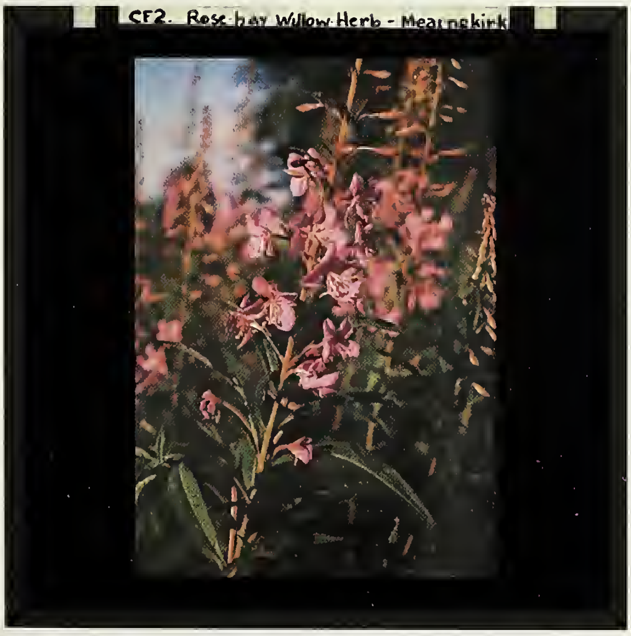
Black & white slide chemically toned - Charles Kirk



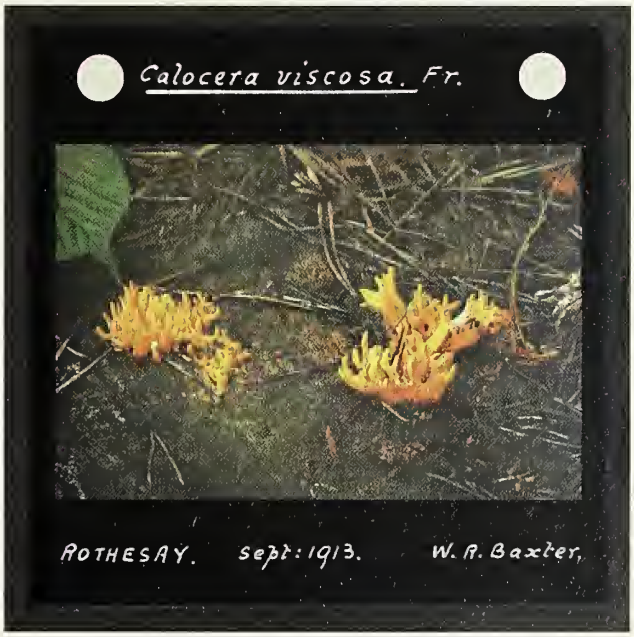
Black & white slide chemically toned - Charles Kirk



Hand tinted black & white slide - Bob MacKechnie



Dufaycolour colour-screen plate - Dr S. Henderson



Autochrome colour-screen plate - William Baxter

The ever popular Lantern Shows continued to delight the membership over many decades. The advent of 2x2 inch transparencies exposed on 35mm colour slide film became increasingly popular. Many people moved over to the economical and convenient new format. Older members continued to refer to projected images as lantern slides, regardless of the format, and they often wrote the minutes of the meetings! It is therefore difficult to state exactly when the last 3_ inch slides were projected.

EARLY PHOTOGRAPHERS IN THE SOCIETY

From the 1890s onwards, many members of the Society were able to prepare Lantern Slides from their photographs taken in the field and the membership was regularly treated to, or probably embarrassed by, photographs of themselves caught on summer excursions. By the beginning of the twentieth century members were now being treated annually to exhibitions of Lantern Slides which were shown "under the auspices of the Photographical Committee." - the forerunner of today's Members' Slide Night. The following account of 1906 includes a list of many of the active photographers in the Society at that time. "The meeting was devoted to the exhibition of lantern slides illustrative of various branches of natural history, topography, etc. Ornithological subjects were dealt with by Messrs. William R. Baxter, Charles Kirk, T. Thornton MacKeith, James W. Reoch, John Robertson, and Hugh Wilson, each of whom showed a fine series of slides representing many species of native Birds, with their nests, eggs, and young, and depicting some of the most attractive phases of bird-life. Botany was illustrated by Messrs. George Herriot, Robert McLean, J. Fleming, William Goodwin, and David R. Somerville, whose slides included views of wild plants in their native habitats, as well as numerous artistic floral studies etc. A series submitted by Mr Robert Garry, B.Sc., contained some fine micro-photographs of Fresh-water Algae. Scottish Geology, as illustrated by highland mountains and glens formed the subject of a beautiful set of slides shown by Mr Reoch; while various other interesting topographical views were submitted by Messrs. Herriot, Somerville, and Wilson."

Most natural history photographers at the beginning of the twentieth century experimented with many of the new postive colour-screen glass plates which were beginning to appear on the market. Most of these processes were impracticable, expensive and produced very unsatisfactory results. They differed from today's colour-slide films in that a positive silver image remained after processing which resulted in a grainy, very dark image which required an especially bright light-source in the lantern. The present day slide-films contain no silver image and consist of a dye image only. Lumière Autochrome plates were the first commercially successful additive colour system and manufacture and distribution began as early as 1906. The first member to use and project colour Lantern Slides to the Society taken on Autochrome was Charles Kirk. He was an eminent Glasgow taxidermist and natural history photographer and on the 28th January 1908 it is recorded that "On behalf of Mr Charles Kirk, Mr John Paterson showed a colour-photograph lantern-slide of eggs of the Razorbill and the Common Guillemot. The variation in the colour and markings were brought out very distinctly. It was stated that this was probably the first occasion on which a slide of birds' eggs photographed by the new Lumière process had been shown in Glasgow."

Very soon after that date many Society members began to show their own home processed Autochromes at the annual lantern slide shows. Notable among these was William Baxter, a past president and former convenor of the Photographic Section, who specialised in photographing plants and fungi mainly on the Isle of Bute. Other exponents of this beautiful colour process were George Herriot, J. R. Jack, John Thomson, Robert McLean and William Pettigrew.

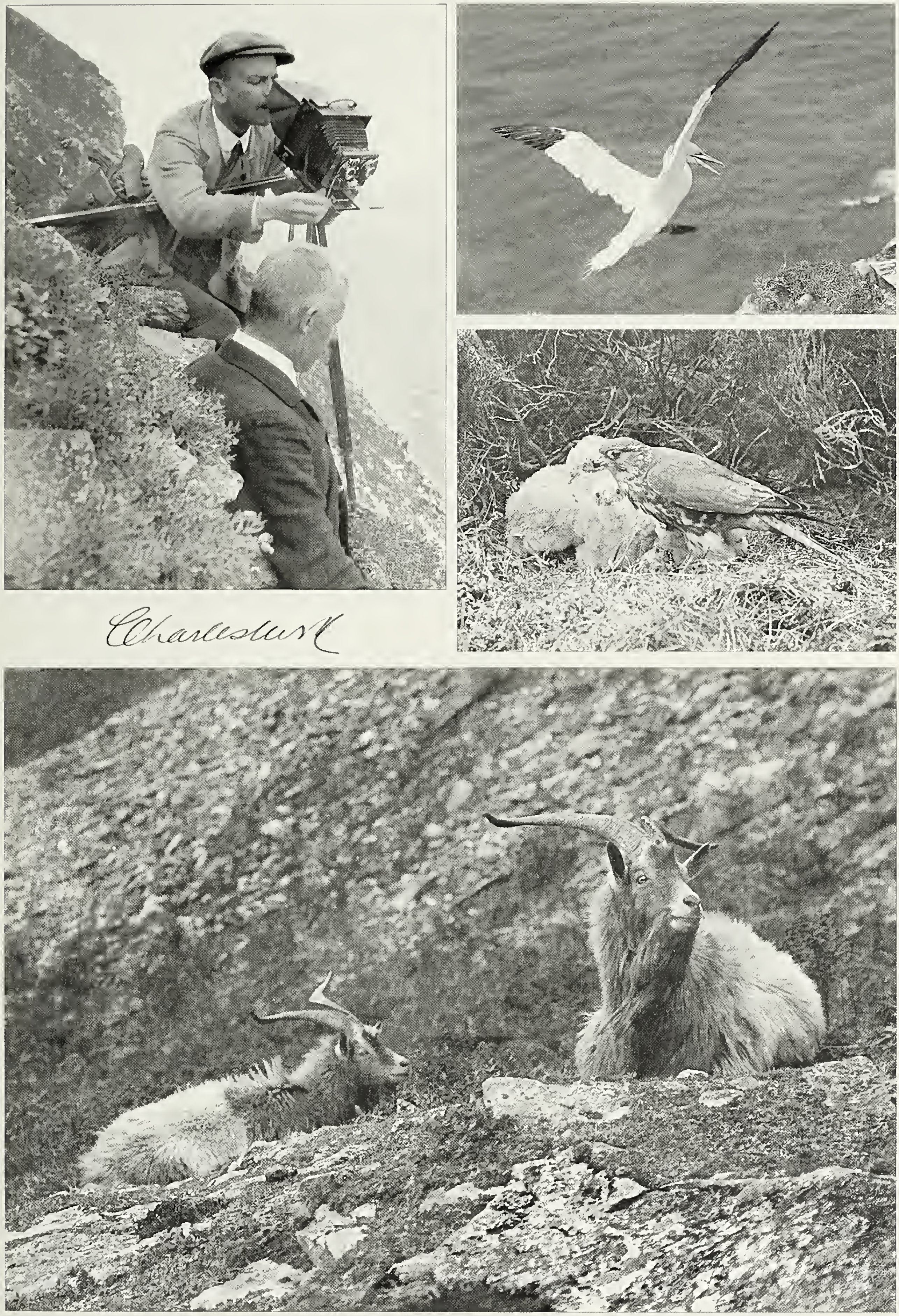
NOTABLE WILDLIFE PHOTOGRAPHERS IN THE SOCIETY

Charles Kirk (1871-1922) was elected a member of the then Natural History Society of Glasgow on the 24th November 1896.

Charles Kirk (Fig. 3) was born and schooled in Edinburgh and later trained as a taxidermist in London. His first employment as a taxidermist was in 1894 with P. D. Malloch in Perth. While living in Perth he became interested in natural history photography. After moving to Glasgow to set up his own business in 1896, he travelled around photographing birds. His favourite haunt was Ailsa Craig where many of his pictures of seabirds were taken, in particular, his gannet photographs. He became famous for his action pictures of sea birds in flight. Considering the limited camera technology of his time, these pictures were a considerable accomplishment. In 1904, Gowans and Gray began publishing a series of pocket picture books on natural history. Each volume was illustrated throughout with sixty high quality plates. Charles Kirk illustrated three such volumnes entitled *Wild Birds at Home*. series 1, 2 and 3. The books were so popular with the public that most were reprinted a number of times followed by second editions. His taxidermy was also highly skilled and innovative. Some of his bird and animal cabinets are still on display in local museums and at the Royal Museum of Scotland in Edinburgh.

Charles Kirk did not hold office in the NHGS but he regularly exhibited mounted specimens of any rare birds sent to him by clients. His Lantern

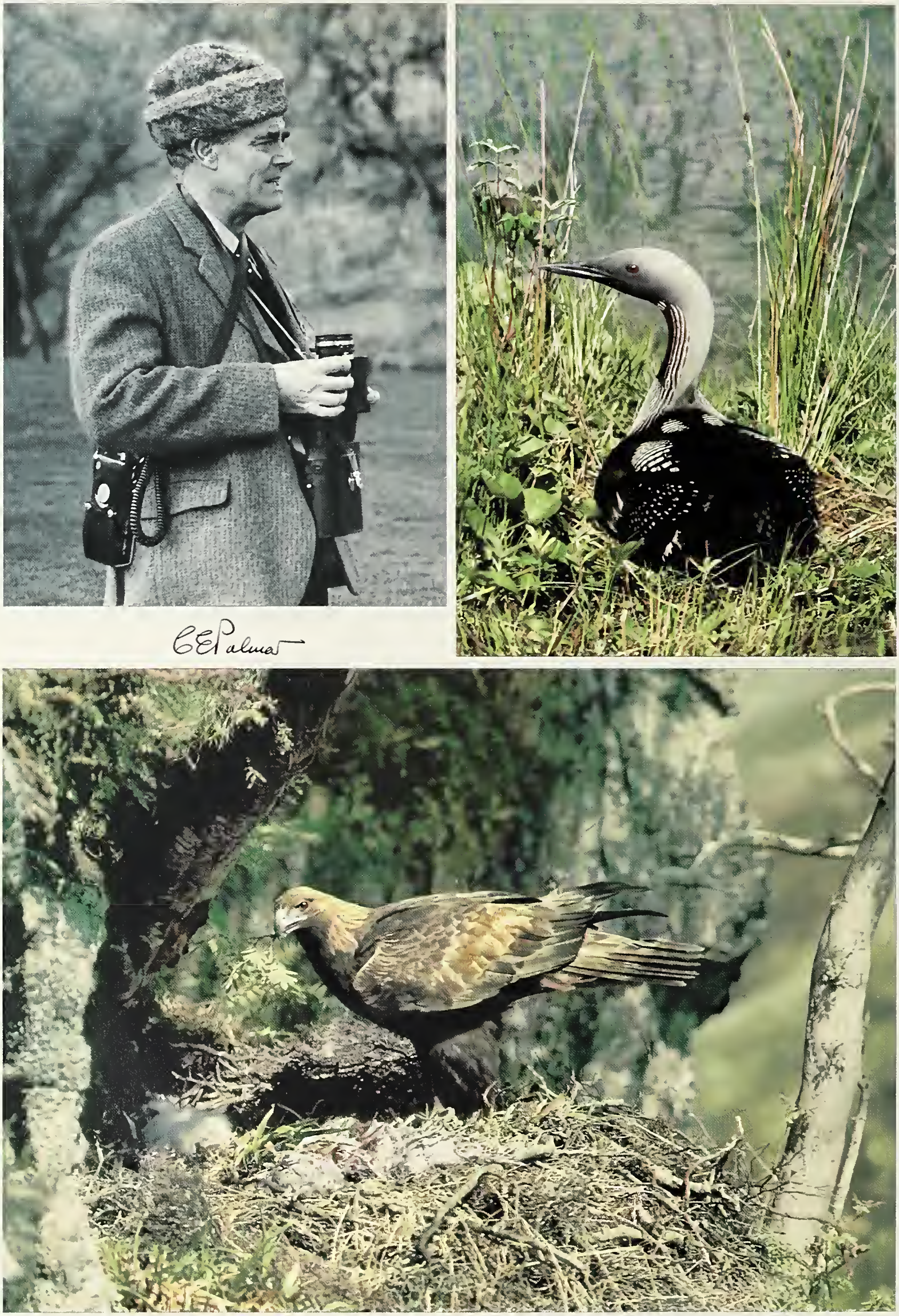
Fig. 3 A selection of wildlife photographs by Charles Kirk (1871-1922).



Charles Kirk

Top left: *Charles Kirk using a half-plate stereo camera on Ailsa Craig.* **Top right:** *Gannet about to land on its nest, Ailsa Craig (undated).* **Middle right:** *Merlin at nest with young (published 1906).* **Bottom:** *Wild Goats on Ailsa Craig (undated).*

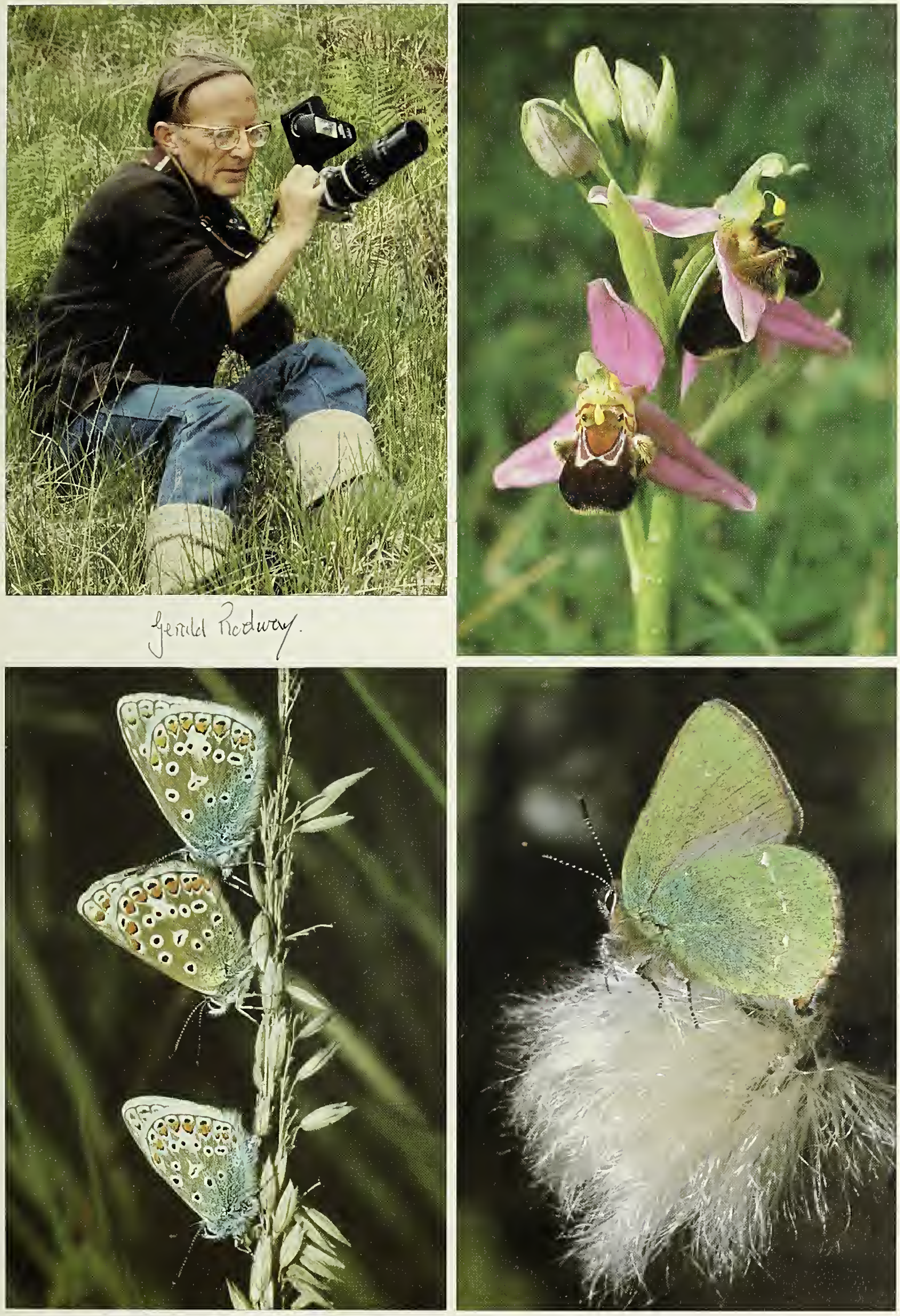
Fig. 4 Bird photographs by Charles Palmar (1919-1986).



CE Palmar

Top left: *Charlie Palmer birdwatching in Glasgow.* **Top right:** *Black-throated Diver on its nest, Loch Maree, 1952.* **Bottom:** *Golden Eagle adorning its nest with a rowan twig, Argyll, 1952.*

Fig. 5 A selection of orchid and butterfly photographs by Gerald Rodway (1926-1985).



Gerald Rodway.

Top left: *Gerry Rodway with a Nikon 35mm camera outfit.* **Top right:** *Bee Orchid photographed in south England.* **Bottom left:** *Common Blue butterflies roosting at night.* **Bottom right:** *Green Hairstreak at rest on a Bog Cotton seedhead.*

Shows, such as *Bird Life of Ailsa Craig* and *Some Wild Birds at Home*, were extremely popular with the membership. The reports of such meetings include "The slides were exceedingly beautiful and reflect great credit on Mr. Kirk" and "How and from where the photographs were taken is yet the wonder of many who were present."

Charles E. Palmar (1919-1986) was elected a member of the then Andersonian Naturalists of Glasgow on the 14th June 1948.

The son of a horticulturist, Charles Palmar (Fig. 4) was born at Leamington Spa in Warwickshire but spent most of his childhood in the Sussex countryside. It was there his lifelong passion for natural history developed. He took up photography at the age of twelve using a simple box camera. Charlie, as he was known to many members of the Society, later used plate cameras for his nest photography of birds, such as the Bittern, as he travelled around the south of England.

The war years brought him to Oban while serving in the RAF. After the war Charlie settled in Glasgow where he took up employment as a medical photographer in Yorkhill Hospital. In 1949 he became Curator of Natural History at Kelvingrove Museum. Throughout his years in Scotland, Charlie devoted himself to bird photography, particularly the Golden Eagle, which became his favourite subject. He made many 16mm cine films about Scottish birds some of which gained national awards. His excellent photographs, both colour and black and white, were published in many Scottish magazines and national bird journals. His wildlife photography was on a par with the work of such great bird photographers as John Markam and Eric Hosking.

Charlie Palmar was elected Photographic Convenor in 1951. He served the Society both as a member of the council on numerous occasions and as Vice-President from 1979-1981. Older members of the Society will remember, with great enthusiasm, evenings spent watching his films and marvelling at the beauty of his intimate portraits of Eagles, Buzzards and other Scottish birds at their nests. He gave many lectures to the Society, his first in April 1948, and the last, and possibly his most memorable lecture, was *Fifty Years of Natural History* which was delivered on the 13th November 1984 shortly before he retired.

F. Gerald Rodway (1926-1985) was elected a member of the then Andersonian Naturalists of Glasgow on the 24th April 1960.

Gerald Rodway (Fig. 5) or Gerry as he was always known to the membership, was brought up in the Gwent and Cotswold countryside. It was there that his life-long interest in natural history developed. Plants were his initial enthusiasm, in particular, orchids and bryophytes. For almost 30 years, Gerry was the Orchid specialist at Glasgow Botanic Gardens where, with great enthusiasm, he built up a very fine collection. His knowledge and expertise was greatly sought after both locally and nationally and he was much in demand as a lecturer - especially by the Society. In later years he developed a passion for butterflies and moths. He travelled the length and breadth of Britain seeking out various species of butterflies which he photographed to a very high standard. Gerry was a strong advocate for conservation - a subject which interested him greatly. He was the prime motivator in the formation of the Glasgow and south-west Scotland Branch of the British Butterfly Conservation Society.

Gerry Rodway was elected as Convenor of the Photographic Section in 1972 - a post which he held until 1982. During this time he presented the Society with many excellent slide shows at the Members' Slide Night. His enthusiasm and advice was an inspiration to many Society members embarking on plant or butterfly photography. He regularly wrote short notes on his observations and records for the *Glasgow Naturalist.* Many of his orchid photographs were displayed in the Botanic Gardens and published in relevant journals.

THE FUTURE

The advent of sophisticated automatic 35mm cameras in recent years has allowed most Society members to indulge in natural history photography. The results of their endeavours are regularly shown at the Members' Slide Night which, since its inception in the 1890s, has continued to be a popular event on the syllabus. Now that the current digital revolution is gaining new converts in imaging, it is possible that future Members' Slide Nights will be presented using yet another new "Lantern" - namely a multi-media projector which will display digital images from a compact disk onto a screen. Whatever imaging technology the future may bring, GNHS members will continue to be at the cutting edge.

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THE “CLYDE CARDS”: AN ACCOUNT OF BIOLOGICAL RECORDING IN THE WEST OF SCOTLAND

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INTRODUCTION AND OVERVIEW

The occasion of the meeting of the British Association for the Advancement of Science (BAAS) in Glasgow in 1901 gave rise to unprecedented activity in collating existing records and carrying out systematic surveys of the fauna and flora of the area. The previous meeting in Glasgow, in 1876, had highlighted the need for collation of species lists, which were published in a small book published in commemoration of the meeting (BAAS, 1876).

The activity continued after 1876, and when, around 1898, a further meeting of the British Association in Glasgow was announced, it was felt to be an opportunity ‘for repairing many of the errors and omissions of the former Handbook, and for bringing to focus the very large amount of work which has been done of late years’. These data were collated and augmented by the efforts of the then active naturalists and published in a second, much larger, Handbook (BAAS, 1901).

The momentum of this activity apparently continued in the early years of the 20th century and, with the prospect of a further BA meeting in Glasgow, in 1928, the records were organised into a card index – the ‘Clyde Cards’ - rather than produce yet another handbook, which would apparently have been prohibitively expensive.

Though the level of activity had been inevitably diminished by the war-years and the subsequent years of depression, and though the naturalists of 1870-1914 – which now seems something of a ‘golden age’ – were succeeded by others of no less distinction, who continued to update the lists, it was not to be until the latter part of the century that comparable effort was to be put into systematic biological surveying and collation of records.

However, this more recent activity has been generated by a variety of needs, in contrast to the single focus of a meeting of the British Association. The dawn of a new millennium is undoubtedly one factor – witnessed by the number of ‘Atlas 2000’ projects implemented for several taxonomic groups. And the political demand for ‘Biodiversity Action Plans’ has highlighted the role of – and in many areas, the need for – local record centres, which have consequently been responsible for increased activity in surveying and collating biological records. In the Greater Glasgow area, the Changing Flora of Glasgow project of 1986-2000 (Dickson, J.H. *et al.*, 2000) has been another notable focus of activity.

The middle years of the 20th century were not, of course, devoid of recording in the field, nor of reviews of the current species lists for individual taxonomic groups. Many examples of these can be seen in the pages of *The Glasgow Naturalist* and the *Annals of Scottish Natural History*. However, there does not seem to have been any focus such as the 1901 meeting of the British Association, nor do they necessarily cover the ‘Clyde Area’ – many concern themselves with individual localities (such as Possil Loch), vice-counties, or are national lists (Scotland, British Isles).

The present review concerns mainly a description of the early lists (1876 - 1928), those responsible for the work, and how it was organised, which brings in associated topics, such as the definitions of the ‘Clyde Area’, and the vice-county system. Developments in subsequent years will be outlined. Finally it discusses and contrasts the present approach to biological recording in the West of Scotland, with particular reference to the City of Glasgow – chosen as a contrasting case study using the most complete body of records readily available to the author.

THE CLYDE AREA

In the context of the three BAAS Handbooks, the term ‘Clyde Area’ has been used in a number of ways, sometimes in an explicitly vague sense, though various definitions have been proposed.

One of the earliest definitions is that of Buchanan White (1872) who included, as one of the ‘natural divisions’ of Scotland, ‘The Clyde Area’ comprising the counties of Ayr, Dunbarton, Renfrew and Lanark, West Stirling (draining to the Clyde), the Loch Lomond catchment area, parts of Argyll (Cowal, Knapdale, Kintyre, upper Loch Fyne), and the Clyde Islands (Arran, Bute, Cumbrae, Ailsa Craig, and various smaller islands).

Buchanan White’s definition would have been available to the compilers of the 1876 list, though it is not apparently used by them. Indeed, the Handbook is entitled *Flora and Fauna of the West of Scotland* – and it will be seen that each of the sections covers a slightly different area, from 'Glasgow and Vicinity' to areas extending in one case to North Uist, and in another, to the Solway coast.

The 1901 Handbook does claim to cover the Clyde Area, and contains a map with the boundary of the area covered and defines several rectangular regions bounded by lines of latitude and longitude, following a system suggested by Clark (1892). Although these rectangles extend further, the records themselves are apparently confined to Buchanan White's Clyde Area.

Patton, in the 1928 Handbook states that his account covers the same area as that chosen for the 1901 handbook, and defines the area as 'the drainage area of the River and Firth of Clyde'.

It is worth noting at this point that the Ordnance Survey's 'national grid' system of dividing up the country into metric squares was not proposed until the late 1930s and did not appear on maps until ten years later.

THE WATSONIAN VICE-COUNTIES

An earlier scheme for dividing up the British Isles for the purposes of biological recording was proposed by the botanist H.C. Watson (1852). This was the system of 'vice-counties': areas which related to the county boundaries as they existed at that date. The larger counties were subdivided – Perthshire contains three vice-counties - and the smaller counties grouped together or included in a larger grouping. There is an interesting example of this simplification strategy in the West of Scotland: the area around Kirkintilloch and Cumbernauld was at that time an 'enclave' of Dunbartonshire, an island surrounded by Stirlingshire; this area was included in the Watsonian vice-county of Stirling. The idea was to create a stable system of boundaries that would be independent of changes in administrative boundaries – and indeed one or two subsequent attempts to modify the V C boundaries on 'rational' grounds have failed for the very reason that the system's stability would be thereby violated.

The vice-county system is still used to this day. In addition to its stability, it has other major advantages: boundaries often correspond to some identifiable feature of the topography such as a stream or a path – though the original feature may now be lost; and most people have an understanding of where counties are in relation to each other, and may have a feeling of loyalty to their own area. Many national organisations such as the Botanical Society of the British Isles (BSBI), and the Mammal Society still have their vice-county recorders. However other organisations define different areas: The Clyde Bird Report confines its attention to Clydesdale and Loch Lomond, and Butterfly Conservation's SW Scotland area includes Dumfries and Galloway, all of Stirling District (as defined in 1996), and extends NW to Mull, Coll, and Tiree.

Dandy (1969) argues for the vice-county system, making the point that 'a large proportion of records ..... cannot be translated into any other system because precise localisation within the vice-counties was not given'. Thirty years or more later, we can only regret that he did not continue by recommending that the additional information should be made available.

Prior to the 1876 lists recording was customarily done on a parish basis. It was just after this time that recording by vice-county was adopted, whereby individual vice county recorders would have surveyed and collated records for their own vice-county. The Clyde Area, insofar as it includes several entire vice-counties, would embrace all these records, though as the subdivisions of the area do not correspond to VC boundaries, the compilers would have had to work from the original records.

THE 1876 HANDBOOK

At a meeting of the Natural History Society of Glasgow on April 25th 1876 a committee consisting of P. Cameron (Convener), D. Robertson, T. Chapman, J. Ramsay, J. Murdoch and J. Stirton was set up 'to consider whether it is advisable to have catalogues prepared of the Fauna and Flora of Clydesdale district, and if so, to endeavour to get competent naturalists to compile such, to consider the best way of getting those published, and to prepare a report on the Botany and Zoology of Clydesdale specifying more particularly those branches which still require to be worked out'.

The stimulus was apparently a letter from the Glasgow Society of Field Naturalists suggesting that a joint committee be set up for the purpose of preparing catalogues for the forthcoming meeting of the British Association. The idea of a joint committee apparently did not find favour with the members of the Natural History Society, though they did offer to identify specimens for the Field Naturalists.

In view of the short timescale (some 4 months), it seems reasonable to assume that the lists published in the 1876 Handbook are largely derived from pre-existing records.

The 1876 handbook is in two parts. Part I is entitled *Notes on the Flora and Fauna of the West of Scotland*, and contains five accounts, the titles of which indicate differences in the areas covered.

On the Mammalia of the West of Scotland
Edward R Alston

Among the Mammalia it is interesting to note (from the perspective of the year 2001) that many species seemed to be on the increase. The red squirrel, now virtually unknown in the area, was actively recolonising Scotland and was widely regarded as vermin on account of the damage it could do to coniferous trees - the first red squirrel in the Loch Lomond area was seen (and killed) in 1830. The grey squirrel, of course, was yet to be introduced to the west of Scotland (in 1892).

The hedgehog and the mole had begun to move north into the highland parts of the area, and the Scottish wild cat had recently become extinct in the Loch Lomond area, which also appeared to be becoming the last stronghold of the badger and the 'yellow-throated marten'. The latter, was referred to as *Martes abietum* - the pine marten, now known as M*artes martes* – and there was controversy as to whether the 'white-throated marten' also seen in the Clyde area was the beech marten *Martes foina* found in continental Europe. Current opinion is that *M. foina* has never been shown to be present in Britain. The rabbit was increasing in numbers and range, and the blue hare, previously confined to the north of the area, was moving south.

The porpoise had been seen in the Clyde 'up as far as Glasgow in the old days when the water was still pure'. The water vole, which is currently seen to be under threat, was then 'abundant'.

On the birds of Glasgow and its vicinity
Robert Gray

Robert Gray was, of course, a founder-member of the Natural History Society of Glasgow. The account is concerned only with Glasgow and its vicinity – as is the list in Part II. He remarks on the persistence shown by birds such as the plover and dunlin, in returning to the few isolated patches of suitable habitat in the Glasgow area that remained - in contrast to the expanses of marsh, mudflat and moorland that their predecessors would have known. He also remarks upon the change of nesting habit of the whitethroat which, though accustomed to nesting in the base of hedgerows, in the urban environment nests much higher above the ground. One of the more startling features of reports about birds from that period, is the frequent references to specimens obtained by shooting. And Gray refers to the eggs of a golden eagle being displayed, unblown, in a class-room of the University at a meeting of the Natural History Society 'with the remark that the eyrie had been robbed but a few hours previously within sight of the great tower'.

The account concludes as it began by noting further species that were stubbornly refusing 'to be scared by the inroads made upon their haunts' and suggesting that the list would 'prove not a less curious record in after-years when all traces of such bird-nurseries have been swept away'. He seems to have been unduly pessimistic; the species he singles out – magpie, dipper, kingfisher, plover, dunlin, greenshank, bittern, redshank, lapwing, and water-rail – are all still to be seen today in the vicinity of Glasgow, though some may be only occasional visitors.

On the insects of Clydesdale
Peter Cameron

The area reviewed here is 'the country drained by the Clyde'. In spite of the undoubted entomological richness of such a large and diverse area, and the zeal of various entomologists over many years, the effort had apparently been 'mainly directed to the Lepidoptera and the Coleoptera' and 'almost wholly confined to the lowland portions of the country'. For Coleoptera, Cameron singles out Possil Marsh, the Tollcross sand-pits, the N Ayrshire coast, Cadzow Forest, Cadder Wilderness and Ben Lomond. In Lepidoptera there were 33 species of butterflies and several moths which were rare, if not in Britain, then in Scotland.

The list of Hymenoptera was thought to be more or less complete – perhaps exceptionally rich in ichneumon wasps and chalcid wasps, along with the Trichoptera (caddis-flies). But the Diptera (flies) and Hemiptera (bugs) were almost wholly neglected.

On the vascular flora of the West of Scotland
James Ramsay

Here the area is extended south to include Wigtonshire and the Stewartry of Kircudbright, and north to Skye, though there appear to be few species noted in the list (in Part II) originating from these extensions. The relative paucity of species in the west compared with the south east of Scotland is noted with some bafflement, though a number of localities are singled out as of particular interest: Possil Marsh ('in which every Glasgow botanist may be said to have been baptized'), the sandy coast of Ayr, Ben Lomond, Ben Vorlich, Arran – particularly Goat Fell, and the ruined walls of Bothwell Castle, Blantyre Priory and Craignethan Castle.

Notable species singled out are: arrow-head (*Sagittaria sagittifolia*) found at Inchinnan and unknown in Hooker's *Flora Scotica* of 1821; a whitebeam ('*Pyrus aria var. fennica*' = *Sorbus pseudofennica*) found on Arran; bird's-nest orchid (*Neottia nidus-avis*) found in 'a few locations in Lanarkshire'; toothwort (*Lathrea squamaria*) on the north bank of the Clyde above Glasgow; and cat-mint (*Nepeta cataria*) on the walls of Craignethan Castle.

The near-disappearance of various fern species is noted with regret. Of the sea spleenwort (*Asplenium marinum*) to be found on Cumbrae: 'the fern-cultivating mania has made sad havoc of it of late'.

On the cryptogamic Botany of the West of Scotland, J Stirton

Again the area discussed extends beyond the Clyde Area, this time as far north as Ben Nevis and north-west to the Outer Hebrides. The area is seen as peculiarly favourable to the growth and development of the moisture-loving species of which this grouping is largely comprised. The richness of the moss flora (*Campylopus* spp, *Dicrania* spp., *Dicranodontium spp.)* around Ben Vorlich is noted, along with a similar hot-spot for *Grimmia* spp. at Dumbarton Rock – and the similarity of the moss population there to that of other similar basaltic trap-rocks in the Kilpatrick Hills and beyond.

A number of 'anomalies' are highlighted; such as *Orthodontium gracile*, which was known from only 3 locations in England and one in Abyssinia, and was found in 1862 at Lennoxtown Woods. The 1862 specimen still exists and has recently been re-verified. The species has also been seen at other locations in the west of Scotland.

Stirton makes a point which I will return to later in this review: *Didymodon recurvifolius* had been reported on the slopes of Ben Lawers by A. McKinlay, one of the notable local botanists of the mid-19th century and whose speciality was mosses. This was the only known remaining location for this species, but Stirton had searched for it in vain, and he laments 'the death of the discoverer precludes the possibility of any more definite information .... as to the exact place of growth'.

Liverworts highlighted are 'the magnificent *Physiotium cochleariforme'* and *Adelanthus carringtonii*, on both Ben Vorlich and Ben Lawers. It is noted that the poor air quality within about 10 miles of Glasgow precludes the growth of lichens except on older trees in 'certain inclosures and secluded glens'. The lichen *Piliporon fibula* previously known in N. America was found on Ben Vorlich in 1871, and was found subsequently on neighbouring mountains.

Species lists

Part II is entitled *The Flora and Fauna of Clydesdale and the West of Scotland* and consists of the species lists, grouped taxonomically by order and family. The work of several notable naturalists is acknowledged in a preface, among whom are: Roger Hennedy (who died later that year) for the greater part of the list of vascular plants and for a contribution to the list of marine algae; Peter Cameron jun. for the saw-flies and gall-flies; Thomas King for the list of mammals, and Richard McKay for the flowering plants and ferns.

As well as the scientific names of the species, common names are listed where available, with locations and an indication of frequency – common, frequent or rare.

In addition to the lists supporting the reviews in Part I, there are lists of reptiles, amphibia, land and fresh-water molluscs, and marine groups: crustacea, molluscs, coelenterates, algae, and diatoms.

THE 1901 HANDBOOK

It is not clear whether the committee set up in 1876 continued after the publication of the 1876 Handbook. It was apparently not functioning by 1893, when a Research Committee was set up with the aims:

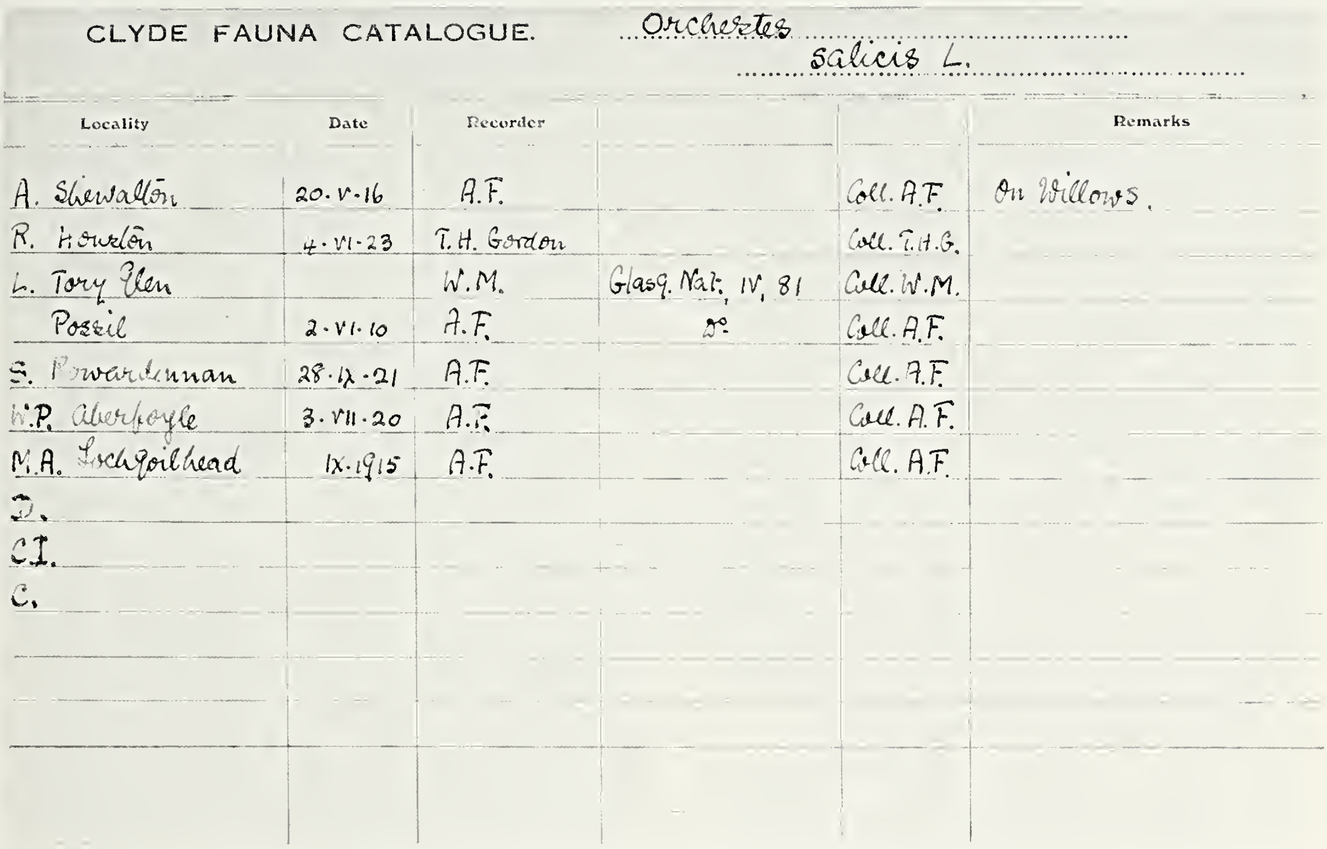
- To further through the work of the Society, the investigation of the Flora and Fauna of the West of Scotland, and in particular, those departments of Invertebrate Zoology and Cryptogamic Botany regarding which no local information has yet been provided
- To aid Members and Associates by giving information regarding the Flora and Fauna of the district, and, as far as possible, by identifying Zoological and Botanical specimens.
- To compile Lists of the local Fauna and Flora

The Committee was chaired by Prof. Thomas King. It is not clear how many members there were as the Proceedings of the Society list Museum and Research Committee members together (some 25 persons in total). Perhaps this indicates that the Museum Committee was a sub-group of the Research Committee.

Though the Journal of the Society testifies to continuing activity in the years between 1876 and 1901 in increasing the number of species recorded in the Clyde Area, the three years preceding 1901 saw unprecedented recording activity, orchestrated by the Research Committee now convened by the Rev. G.A. Frank Knight, who himself was an active recorder of land and fresh-water molluscs, and produced the list of Mollusca and Brachiopoda for the Handbook. Other notable naturalists taking part were the entomologists Robert Henderson, whose Diptera collection survives at Kelvingrove Museum and at the University of Glasgow, Anderson Fergusson whose Coleoptera collection likewise survives, J. Russell Malloch and James J.F.X. King. The botanists included G.F. Scott Elliott and William Stewart, and John R. Lee, who was to produce a successor to Hennedy's *Clydesdale Flora* and had just begun his work. Hugh Boyd Watt was the mammal recorder.

The 1901 Handbook is a much more substantial volume than its predecessor of 1876. The editors point out, though the lists are longer than in 1876, and there are more taxonomic groups covered, the study of some groups had only begun in the preceding three years, and there were still groups missing from the lists.

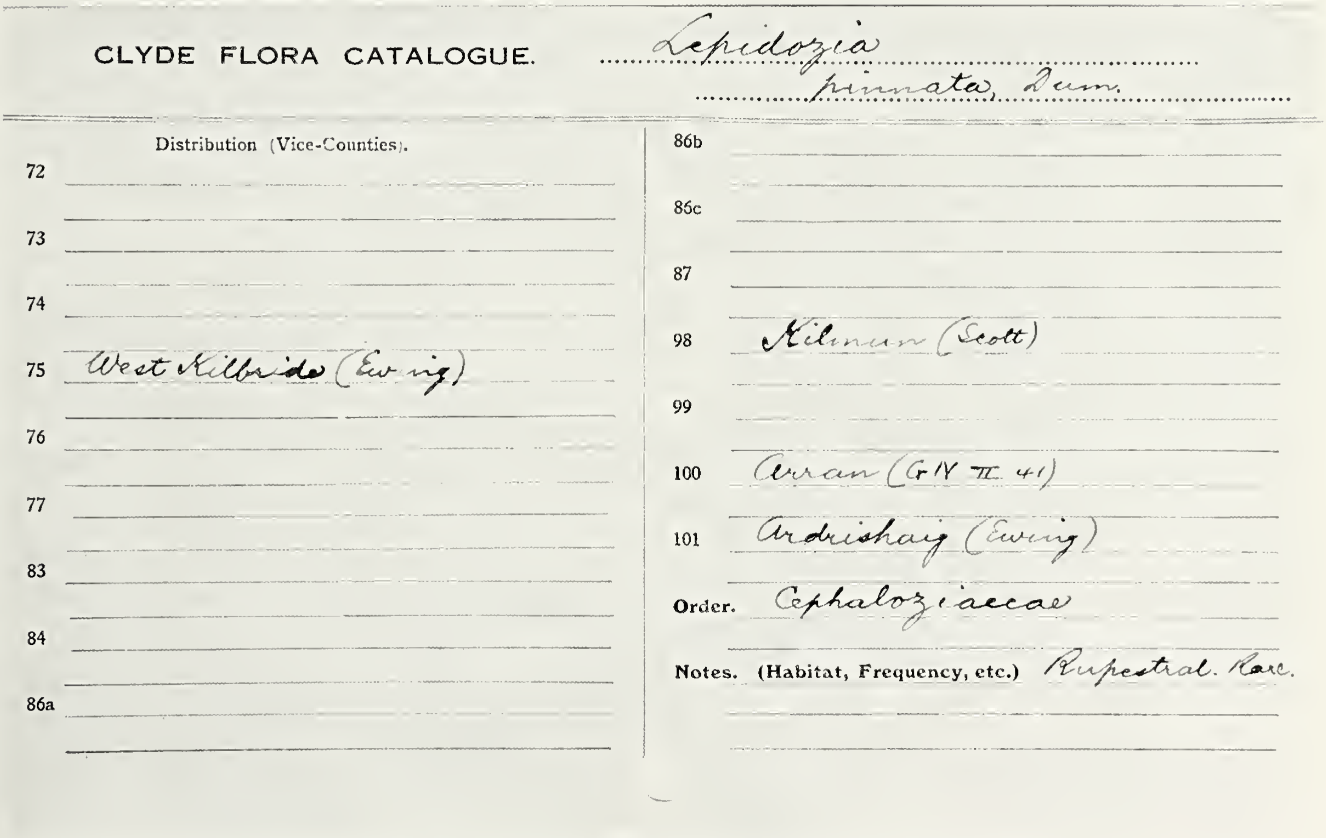
Notable additions to the groups covered are: fish, several insect groups including crane-flies and dragon-flies, millipedes, spiders, freshwater algae, and microscopic fungi. The study of fungi in general was stimulated by a visit of the Cryptogamic Society of Scotland to Glasgow in 1880. The level of interest was sustained by the fact that its President Thomas King was also a member, and later, President of the Natural History Society.



CLYDE FAUNA CATALOGUE. Orchestes salicis L.

Locality	Date	Recorder			Remarks
A. Shewalton	20.v.16	A.F.		Coll. A.F.	On Willows.
R. Houston	4.vi.23	T.H. Gordon		Coll. T.H.G.	
L. Tory Glen		W.M.	Glasg. Nat. IV, 81	Coll. W.M.	
Possil	2.vi.10	A.F.	do	Coll. A.F.	
S. Rowardennan	28.ix.21	A.F.		Coll. A.F.	
W.P. Aberfoyle	3.vii.20	A.F.		Coll. A.F.	
M.A. Lochgoilhead	ix.1915	A.F.		Coll. A.F.	
D.					
CI.					
C.					

Fig. 1 Clyde Card for the weevil *Orchestes salicis*



CLYDE FLORA CATALOGUE. Lepidozia pinnata, Dum.

Distribution (Vice-Counties).

72
73
74
75 West Kilbride (Ewing)
76
77
83
84
86a
86b
86c
87
98 Kilmun (Scott)
99
100 Arran (G N II 41)
101 Ardrishaig (Ewing)

Order. Cephaloziaceae

Notes. (Habitat, Frequency, etc.) Rupestral. Rare.

Fig. 2 Clyde Card for the liverwort *Lepidozia reptans.*

Apart from the lists themselves there are several accounts: G.F. Scott Elliot reviews the Botany of the area, and F.O. Bower gives an account of the History of Botany in Glasgow.

John Renwick and Richard McKay give an account entitled *Measurements of Notable Trees*, an enthusiasm shared by our current President. There is also a curious chapter entitled *Anthropology of the Clyde Valley* by Ebenezer Duncan which concerns skull measurements (obtained from local hatters). These are compared with measurements obtained from London hatters, and Duncan predicts that the comparatively high incidence of 'broad-headed' and 'long-headed' skulls in the West of Scotland will become less marked as a result of 'the continual influx of recruits from all parts of Britain and Ireland'.

The Handbook also contains several geological accounts: of the geology of the area by John Horne, of the rocks and minerals, of the glaciation of the area, locations for carboniferous fossils, and lists of the various fossils arranged in taxonomic groups.

1928: THE CLYDE CARDS ARE BORN

Professor Scott Elliott (1901) had expressed the hope that 'the lists would be kept up to date by specialists appointed for the purpose'. It is not clear for how long the Research Committee continued to exist. However, Andrew Barclay in his account *The Local Fauna* in the 1928 Handbook mentions that the 'anticipatory enthusiasm is inspiring, which is the more pronounced in contrast to the late apathy', an apathy which he dates from the onset of war and which 'continued throughout the peculiar subsequent period in civic history'.

Barclay describes how the idea of a card catalogue of the local Flora and Fauna had been under discussion for several years as 'an essential accessory to the modern methods in research work', but that none of the societies had 'ventured to put them into practical form'. The announcement of the forthcoming 1928 meeting of the British Association provided the required stimulus: a committee was set up comprising representatives of the University, Natural History Society, Andersonian Naturalists, Microscopical Society, Biological Section of the Royal Philosophical Society, Scottish Marine Biological Association, and several other local societies as well as individual naturalists under the presidency of Professor L.A.L. King. The group included many naturalists who had assisted with the 1901 catalogue.

The catalogue, on 5"x8" record cards, was 'creditably complete' by the time of publication of the 1928 Handbook. It appears to contain only additions to the lists since 1901, though some of the entries are references to published accounts which may well include earlier records. These cards still exist and are located in the Natural History Department at Kelvingrove Museum in two small filing cabinets containing some 1600 cards (Flora) and 2,800 cards (Fauna) respectively. Each card holds information about one species, though many are blank except for the species name.

The layouts of the Fauna and Flora cards differ. Figure 1 shows the card for the weevil *Orchestes salicis* (now *Rhynchaenus salicis*): the first column gives the locations where this species has been observed – often only a single alphabetic character is shown: here it obviously signifies the vice-county. It can be seen that the earliest record of this species was by Fergusson at Possil in 1910, and this highlights the fact that some momentum was maintained in the years after the 1901 meeting. Figure 2 shows the card for the liverwort *Lepidozia reptans*: the locations are classified by vice-county; frequently only a reference to a journal or an individual is cited.

The 1928 Handbook comprises ' a collection of articles upon various aspects of Glasgow and its neighbourhood'. Andrew Barclay's review *The Local Fauna* has already been mentioned: he describes how, by this time, the grey squirrel was beginning to oust the red; in spite of the ever-increasing size of the city, there was no apparent loss of ornithological diversity, except perhaps the feared extinction of the hen-harrier; extensions to the lists of insects had been made, notably the Diptera with R. Henderson, J.J.F.X King, J.R. Malloch (veterans of the 1901 lists) and P.E. Grimshaw all making notable contributions - and progress had also been made on other invertebrate groups; and lastly, a technique recently developed in Glasgow for cultivating protozoa (particularly *Amoeba proteus*) for use in education, had had the two-fold result of discovering a new species of *Amoeba*, and exporting the 'Glasgow amoeba' to laboratories across the world.

In the 1928 review *The Local Flora*, Donald Patton, at that time President of the Society, says that the 1901 account 'is still an excellent guide to the Clyde area' and confines himself to general description of the types of habitat to be found there, though he mentions some of the more interesting species. He also states that 'every spring the naturalists of Glasgow arrange an excursion, the main purpose of which is to see the purple saxifrage in bloom. To this end, they make for one or other of the mountains around and to the north of the upper reaches of Loch Lomond'; this gentle habit has clearly been lost in the intervening years. J.R. Lee and D.A.Boyd, veterans of the 1901 lists, were among the conveners of the various botanical sub-sections.

THE LATER HISTORY OF THE CLYDE CARDS

Further information about the Clyde Cards is scanty. The Clyde Card Catalogue Committee had its own bank account from 1932 (when the signatories were W. Cousin and L.A.L King) until 1957 (signatories Elsie Conway and R.H. Johnstone). The cards themselves, however, show no activity from about 1936, though there was a period of updating by the curators of Natural History at Kelvingrove Museum in the late 1980s and early 1990s.

The closing of the bank account in 1957 is puzzling in view of a remark by Mackechnie (1958); referring to a BSBI project for producing distribution maps of the flowering plants and ferns of the British Isles on a 10km square basis he adds: "When that scheme is completed it is anticipated that the energies of our local recorders of all forms of plant and animal life will be diverted to assembling the records for the new Clyde Card Catalogue". This period also saw the formation of the Nature Conservation Committee and the focus was more on individual sites ("Sites of Special Scientific Interest") than on the species lists for the wider area.

The latest reference to the Committee so far found is in Ribbons (1961), however, it is not clear from the context whether this refers to a Committee which was still active at that date. Enquiries have been made of current members of the Society who were members at that time, but no evidence of further activity has come to light. Undoubtedly, the second period of war and post-war depression would also have had its effect; however, it is regrettable that the 1958 BAAS meeting – in the era of 'you never had it so good' - did not have the same galvanising effect as the 1928 Meeting had.

Up until the 1980s, the Clyde Cards were kept in the Zoology Building of the University of Glasgow. When the room where they were kept was demolished during some building work, they may well have perished had not Geoff Hancock, then Curator of Invertebrate Zoology at Kelvingrove, saved them by taking them to that Museum.

A MODERN PERSPECTIVE

The Clyde Area

From the point of view of a local or national Biological Record Centre in the opening years of the 21st century, both the Clyde Area as an example of the 'natural division' method of dividing up the country, together with the vice-county system, must be seen primarily as an administrative convenience. It is useful for the botanical (for example) vice-county recorder for Renfrew to know where his area ends and the vice-county of Lanark begins. Similarly it is helpful for a local organisation such as the Glasgow Natural History Society (GNHS), whose professed area of interest is traditionally 'The Clyde Area' to know where the boundaries of that area lie – although the Society has apparently never felt bound by those limits in its excursion programmes over the years.

From a national perspective, the vice-county system, designed to divide the country into approximately equal areas, can give useful information about how widespread a species is, and an approximate atlas of its distribution – though information based on 10km grid-references serves those purposes even better, and is hardly more difficult for the individual recorder to generate. On the other hand, the Clyde Area has an undoubted geographical identity, and can meaningfully be said to 'contain' its Flora and Fauna, in a more obvious sense than a vice-county does.

However, the need now is to produce distribution maps or lists of species or species groups, and to produce lists of species for identifiable localities such as Sites of Special Scientific Interest (SSSIs), nature reserves, lochs, woodlands and parks. The concern to preserve and enhance biodiversity – that is, to increase the diversity of species in a particular area, and to manage habitats to promote the survival of species seen to be under threat – also demands more precise recording, not only of location, but also of numbers of species and evidence of breeding. It is important also to record habitats and how they change over the years.

In this context, the locations of field records need to be more precisely recorded, preferably as an Ordnance Survey grid reference with an accuracy of better than 1km. This requirement is assisted by the ready availability of global positioning systems (GPS) which use satellite transmissions to locate the position of the observer – which may however be, necessarily, not exactly the same as the location of the species being recorded.

It has been mentioned that historical records are valuable in that they indicate species which perhaps have been under-recorded in later years, as well as species which are now extinct in the locality for whatever reason – and those reasons may be worth investigating. However, there seems to be little intrinsic usefulness in publishing vice-county lists per se (for example). This view arises from the oft-encountered published reference to a species with no clue as to its locality except the vice-county; the record cannot be shown on a distribution map - even a 10km square grid-reference would be preferable in this respect. And of course, it is difficult to verify such a vague record, particularly in later years when the original observer is no longer alive, and his detailed records perhaps lost – in these circumstances the modern naturalist echoes the lament of James Stirton quoted above.

As with all scientific accounts, the requirement seems to be to provide as much information as possible. Keeping voucher specimens in a collection or herbarium is a long-established way of verifying the species identification; recording the location in sufficient detail is equally important if the continued presence of the species is to be confirmed in later years. There may, of course, be good reasons why the location of some species should not be publicised; for example, to protect an endangered species, or because of the wishes of a landowner. This requirement can be implemented very easily in a computer-based system where sensitive records can be withheld from all but specially authorised users, yet the information remains available for posterity.

A modern biological database

Though many naturalists still maintain card-indexes, the computer is rapidly becoming the favoured data repository. The proposed National Biodiversity Network is a plan to link the databases of all local Biological Record centres through the Internet. Members of Glasgow Natural History Society have been active over the last three or four years entering records for the Greater Glasgow area into a desktop computer at Kelvingrove Museum, and though much of the work has been voluntary, some has been funded by Glasgow City Council on the grounds that the data that pertains to Glasgow is fundamental to the City's Biodiversity Action Plan, and the speed and convenience of computerised access to that data is a necessary part of implementing that plan.

This database now holds some 115,000 records including data taken from the various local Floras – by Hopkirk, Hennedy, Lee and *The Changing Flora of Glasgow* (though the latter information is at present easily accessible only in summary form) – also from the *Glasgow Naturalist*, the Clyde Bird Reports, the Butterfly Conservation database, and of course it includes a number of records from the Clyde Lists of the 1876 and 1901 Handbooks and the Clyde Cards.

Though there are known to be further records at Kelvingrove Museum, and in the possession of members of the Society and others, which could extend the number of species recorded in the database, the existing complement gives a reasonable indication of the coverage, particularly for the City of Glasgow itself. The discussion of this list which follows will, it is hoped, provide an interesting comparison with the situation at the time of the BAAS meetings.

The Appendix shows a summary by taxonomic group of the species which have been observed at locations within the present boundary of the City of Glasgow. Some of the groups are orders, some are classes and some families etc., according to common practice in each area of taxonomy. The first numeric column shows the number of UK species in the group, the second column is the number of species which have been recorded in Glasgow since 1950, the third, the number of species which have not been recorded since before 1950, and the fourth column is the sum of columns 2 and 3 – that is, the total number of species in that group which have been recorded in Glasgow.

A number of caveats are necessary. Firstly, some of the figures shown in the UK species column are based on incomplete lists - the database does not yet hold the complete UK list for that group; and, of course, many of the species that are included would not be expected either in Scotland or in the habitats which exist in the Glasgow area. The main omissions are in the lower plants (with the exception of the larger fungi), the more primitive animals (eg *Amoeba proteus*), and many invertebrate groups (even some of the major insect groups are incomplete). Particularly notable is the group *Monera*, the kingdom of bacteria, which yet has only two entries - cyanobacteria and filamentous bacteria - reflecting the fact that the bacteria have generally been ignored by the field naturalist, even though they form an integral part of the ecosystem of the species of interest. However, the numbers do give some indication of the diversity of each of the other groups, and therefore an indication of whether more species may well be found there. Note also that some of the entries in the description column indicate the names of the species found in the Glasgow area, rather than being a description of the group in general.

Secondly, both the pre- and post-1950 totals include species which were 'casuals' – single occurrences that did not persist. Examples include a hoopoe that visited the Fairfield shipyard for a few days in 1923 (another was seen in 1996 elsewhere in Glasgow), plants such as the culinary lentil and the grape-vine found on a coup, and exotic long-horn beetles that occasionally arrive here in cargoes of timber.

Several of the pre-1950 species are known to be extinct. But many are undoubtedly still present, and examination of the table shows which groups are likely to contain such under-recorded species that the present-day naturalists of Glasgow should perhaps make an effort to try to find again. Unfortunately, the list of over 2,600 species is too long to include in this account.

The table omits groups for which the database contains no records for Glasgow. Many of these are groups of marine organisms, but others may again indicate under-recording.

The higher-plant list is undoubtedly substantially complete, thanks to *The Changing Flora of Glasgow*. Among the lower plants, the larger fungi, as ever, show the most complete coverage, though the records come, in the main, from a few city parks and much of the other urban greenspace and woodland of Glasgow is unrepresented – the current need is not only to show that they exist within this arbitrary boundary, but also how widespread they are. The unicellular plants and slime moulds are apparently completely neglected; and the algae and mosses are probably under-represented.

In the animal kingdom, the bird, fish, mammal and butterfly lists are probably substantially complete, save for the lack of recent records of the smaller mammals. The number of butterfly species recorded is significantly increased compared with pre-1950; and recent moth records are known to exist, but are not included in the present totals. Coleoptera is the only other insect group which shows a greater number of records after 1950 than before that date – a testament to the efforts of the late Dr. Roy Crowson. The Diptera and Hymnenoptera, both very actively recorded at the end of the 19th century, would certainly repay renewed activity now; and the figure shown for Diptera in the UK - 7850 - an example of a list which is known to be incomplete, are probably under-recorded. Perhaps there are more species to be found within other insect groups such as scorpionflies; and in the other invertebrate groups such as earthworms, spiders, amphipods, and isopods (woodlice). The flatworm, centipede and millipede lists may be substantially complete, but more information about their distribution would be desirable. There are current plans to carry out mollusc surveys – a significant number of species have not been recorded since 1950, and again, the records come mainly from a few sites. The protozoa and other lower animals are also apparently largely unsurveyed.

These remarks have arisen from consideration of the records for the Glasgow area, but perhaps they can be generalised to the wider area. Where there is a vice-county recorder for a taxonomic group, then the list for that group in that area will (usually) be substantially complete and up to date. For other groups, the coverage will be dependent on the interests of local naturalists, and visits by specialists from other parts of the country. However, it may well be more effective for local naturalists to collect specimens and send them to referees for identification.

Consideration of the distribution of species records also shows that there is a marked tendency for naturalists to visit the 'interesting' sites; that is, those that are species-rich or hold unusual species. Examples are Possil Marsh, Hogganfield and Bishop Lochs, Tollcross sandpits (in former days), and the banks of the Clyde at Carmyle and Kenmuir. Urban Glasgow tends to be neglected, except for the more obvious species such as vascular plants, birds and the larger insects (eg macro-Lepidoptera, Coleoptera, Odonata). There is an apparent shortage of records of fungi, most invertebrate groups, and - excepting a recent water-vole survey – the smaller mammals.

So the situation is in many ways similar to that 100 years ago. Many specialist naturalists are active in the West of Scotland, but though most taxonomic groups have been studied at one time or another over the past 150 years, the coverage of many groups of invertebrates and 'lower' plants has been sporadic. From time to time special surveys have been implemented using visiting experts in fields that are not covered by local naturalists, and this is a useful way of filling gaps in our knowledge, though the number of locations that can be covered in such visits may be limited.

We can still usefully recommend today an 'investigation into the Flora and Fauna of the West of Scotland and in particular those departments of Invertebrate Zoology and Cryptogamic Botany regarding which no local information has yet been provided' – although we would now have to modify this objective slightly by appending the words 'and those regarding which no information has been provided within the last 50 or more years'.

Andrew Barclay, in the 1928 Handbook, expressed the hope that the information in the Clyde Card Catalogue would be published, and that 'since the work is for the benefit of all naturalists, some public body will assist them in the publication, so that it may be made accessible to all'. It remains to be seen whether the advent of a National Biodiversity Network accessible through the Internet will finally realise this aspiration.

ACKNOWLEDGEMENTS

I am grateful to Keith Watson for amendments to the Glasgow species list, also to Richard Sutcliffe and Geoff Hancock for helpful comments on that list; to Mrs Betty Crowson, Prof. Jim Dickson, and Mr Alan Stirling for information about recording activity in the 1950s; and to Dr Jack Gibson for a note on the Faunal Areas of Scotland.

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Appendix: Fauna and Flora records for Glasgow

Group	**Description**	**UK species**	**Since 1950**	**Before 1950**	**Total**
Monera	prokaryotes	2			
Protosteliomycetes	primitive slime moulds	8			
Ceratiomyxomycetes	slime moulds	1			
Dictyosteliomycetes	cellular slime moulds	12			
Acrasiomycetes	amoeboid slime moulds	3			
Myxomycetes	slime moulds	405			
Deuteromycotina	fungi imperfecti	124			
Chytridiomycetes	uniflagellate fungi	2			
Oomycetes	biflagellate fungi	106			
Zygomycotina	zygomycete fungi	5			
Ascomycotina	ascomycete fungi (lichens)	8785	132	7	139
Russulales	basidiomycete (gill) fungi	6597	124	36	160
Gasteromycetes	basidiomycete (stomach) fungi	255	4		4
Teliomycetes	rusts	668	5		5
Chlorophyta	algae	93	3		3
Rhodophyta	red algae	2			
Xanthophyta	algae	1			
Bacilliariophyta	diatoms	1			
Hepaticae	liverworts	581	34		34
Anthocerotae	hornworts	14			
Musci	mosses	1953	95	58	153
Lycopodiopsida	clubmosses & quillworts	31	1		1
Equisetopsida	horsetails	39	6	1	7
Pteridopsida	ferns	284	22	1	23
Ginkgoopsida	ginkgo	1			
Pinopsida	conifers	143	5		5
Magnoliidae	dicotyledons	7763	892	90	982
Liliidae	monocotyledons	2228	232	23	255
Myxospongida	sponges	3	1		1
Actiniaria	hydra	13	3		3
Tricladida	flatworms	29	8	1	9
Gordioidea	horsehair worms	5			
Enoplida	nemertean worms	2			
Phylactolaemata	moss animals	9	1		1
Mollusca	non-marine molluscs	304	45	32	77
Oligochaeta	oligochaetes	27	3		3
Lumbricina	earthworms	142	2		2
Acanthobdellida	leeches	1	1		1
Rhynchobdellida	leeches	12	6		6
Gnathobdellida	leeches	2	1		1
Pharyngobdellida	leeches	8	4		4
Diplopoda	millipedes	118	16		16
Chilopoda	centipedes	74	6	1	7

Collembola	springtails	2			
Protura	proturans	12			
Diplura	two-pronged bristle tails	12			
Thysanura	three-pronged bristle tails	14	1		1
Ephemeroptera	mayflies	77	3		3
Odonata	dragonflies	91	10		10
Plecoptera	stoneflies	73	9		9
Phasmida	stick and leaf insects	6			
Orthoptera	grasshoppers and crickets	47	1		1
Dermaptera	earwigs	8	1		1
Dictyoptera	cockroaches	14	3		3
Psocoptera	booklice	142	3	3	6
Phthiraptera	sucking lice	39			
Thysanoptera	thrips	158			
Hemiptera	bugs	1652	17	1	18
Neuroptera	lacewings	203	3		3
Coleoptera	beetles	8229	370	153	523
Strepsiptera	stylops	25	1		1
Mecoptera	scorpionflies	5			
Trichoptera	caddisflies	287	10		10
Lepidoptera	butterflies and moths	3154	130	3	133
Diptera	flies	7850	69	395	464
Siphonaptera	fleas	109	5	1	6
Hymenoptera	sawflies, bees, wasps, ants	5320	31	66	97
Anostraca	fairy shrimps	3			
Notostraca	tadpole shrimps	1	1		1
Cladocera	water fleas	100	14	5	19
Ostracoda	ostracods	184	1	3	4
Calanoidea	copepods	14		1	1
Cyclopoida	copepods	11	1	1	2
Branchiura	fish lice	3		1	1
Bathynellaeea	cave shrimps	2			
Mysidacea	opossum shrimps	2			
Isopoda	isopods	113	13	9	22
Amphipoda	amphipods	29	1		1
Pseudoscorpiones	false scorpions	88	3	2	5
Opiliones	harvestmen	78	2		2
Araneae	spiders	1628	12	15	27
Acari	mites	115	2		
Ixodida	ticks	31	2		
Heterotardigrada	tardigrades	4			
Eutardigrada	tardigrades	1			
Hyperoartia	lampreys	6	2		2
Lamniformes	basking shark	1			
Chondrostei	sturgeon	1			
Isospondyli	salmonid fish	17	5		5
Haplomi	pike	1	1		1
Ostariophysi	minnow, loach, carp etc	20	6		6
Apodes	eel	1	1		1
Anacanthini	burbot	1			
Percomorphi	perch	16	2		2

Scleroparei	bullhead	2	1		1
Thoracostei	sticklebacks	3	2	1	3
Heterosomata	flounder	1	1		1
Urodela	newts and salamanders	6	2		2
Anura	frogs and toads	11	2		2
Chelonia	turtles and tortoises	9	1		1
Squamata	snakes and lizards	9			
Gaviiformes	diving birds	10	3		3
Podicipediformes	grebes	10	4	1	5
Procellariiformes	petrels	21	2		2
Pelecaniformes	gannet, shags, etc.	8	3		3
Ciconiiformes	storks	19	2	1	3
Phoenicopteriformes	flamingos	1			
Anseriformes	ducks and geese	110	35	1	36
Accipitriformes	buzzards	27	7	2	9
Falconiformes	raptors	11	3		3
Galliformes	pheasants, grouse, etc.	18	4	1	5
Gruiformes	rails & crakes	21	5		5
Charadriiformes	wading birds	196	44	6	50
Pteroclidiformes	sandgrouse	1		1	1
Columbiformes	pigeons and doves	10	6		6
Psittaciformes	parrots	4			
Cuculiformes	cuckoos	4	1		1
Strigiformes	owls	17	4	2	6
Caprimulgiformes	nightjars	4		1	1
Apodiformes	swifts	7	1		1
Coraciiformes	hoopoe	7	1		1
Piciformes	woodpeckers	15	3		3
Passeriformes	passerine birds	344	78	4	82
Insectivora	hedgehog, mole, shrews	8	5		5
Chiroptera	bats	33	4	1	5
Lagomorpha	rabbits and hares	5	2		2
Rodentia	rodents	24	7	3	10
Cetacea	whales and dolphins	25	2	1	3
Carnivora	carnivores	19	9	1	10
Pinnipedia	seals	8	1		1
Perissodactyla	odd-toed ungulates (horse)	1			
Artiodactyla	even-toed ungulates (deer)	15	1	1	2

GLASGOW NATURALIST Vol. 23 Part 6 pp 100-103(2001)

THE *FAUNA OF SCOTLAND* SERIES

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INTRODUCTION

Just over a quarter of a century after its establishment in 1851 the Natural History Society of Glasgow launched an ambitious project, called the Fauna of Scotland series. This may be little known to many of the Society's members nowadays, but although the series did not actually succeed in its primary aim, in retrospect it can be seen to have laid the foundation for a great deal of pioneer research on the natural history of the Clyde area. In this 150th anniversary year, therefore, it seems desirable to draw attention to this early work of our Society.

THE 1876 B.A. HANDBOOK

In September 1876 the British Association held its Annual Meeting in Glasgow, and a Handbook on many aspects of local natural history was published to accompany the meeting. The production of this Handbook was largely undertaken by the Glasgow Society of Field Naturalists (established 1871, and apparently particularly active in botany) a society which later, in April 1879, amalgamated with the Natural History Society of Glasgow.

The format of this Handbook was slightly unusual. On the front cover, under the British Association heading, it was called 'On the Fauna and Flora of the West of Scotland', but the contents were divided into two distinct parts, each part with its own title-page. The first of these was entitled 'Notes on the Fauna and Flora of the West of Scotland' and contained accounts, in narrative form, of the mammals, birds, insects, vascular flora and cryptogamic flora. The second, and main, part was entitled 'A Contribution towards a Complete List of the Fauna and Flora of Clydesdale and the West of Scotland. Compiled under the auspices of the Society of Field Naturalists, Glasgow', and this contained Clyde locality lists, sometimes extensive, on a great many subjects. Several members of the Natural History Society of Glasgow, although not personally members of the Field Naturalists, made significant contributions, and this assistance was acknowledged in the Preface and in the text.

For its time, this Handbook was an important publication, which produced pioneer accounts of many aspects of Clyde fauna and flora.

CATALOGUES OF THE FAUNA OF THE WEST OF SCOTLAND

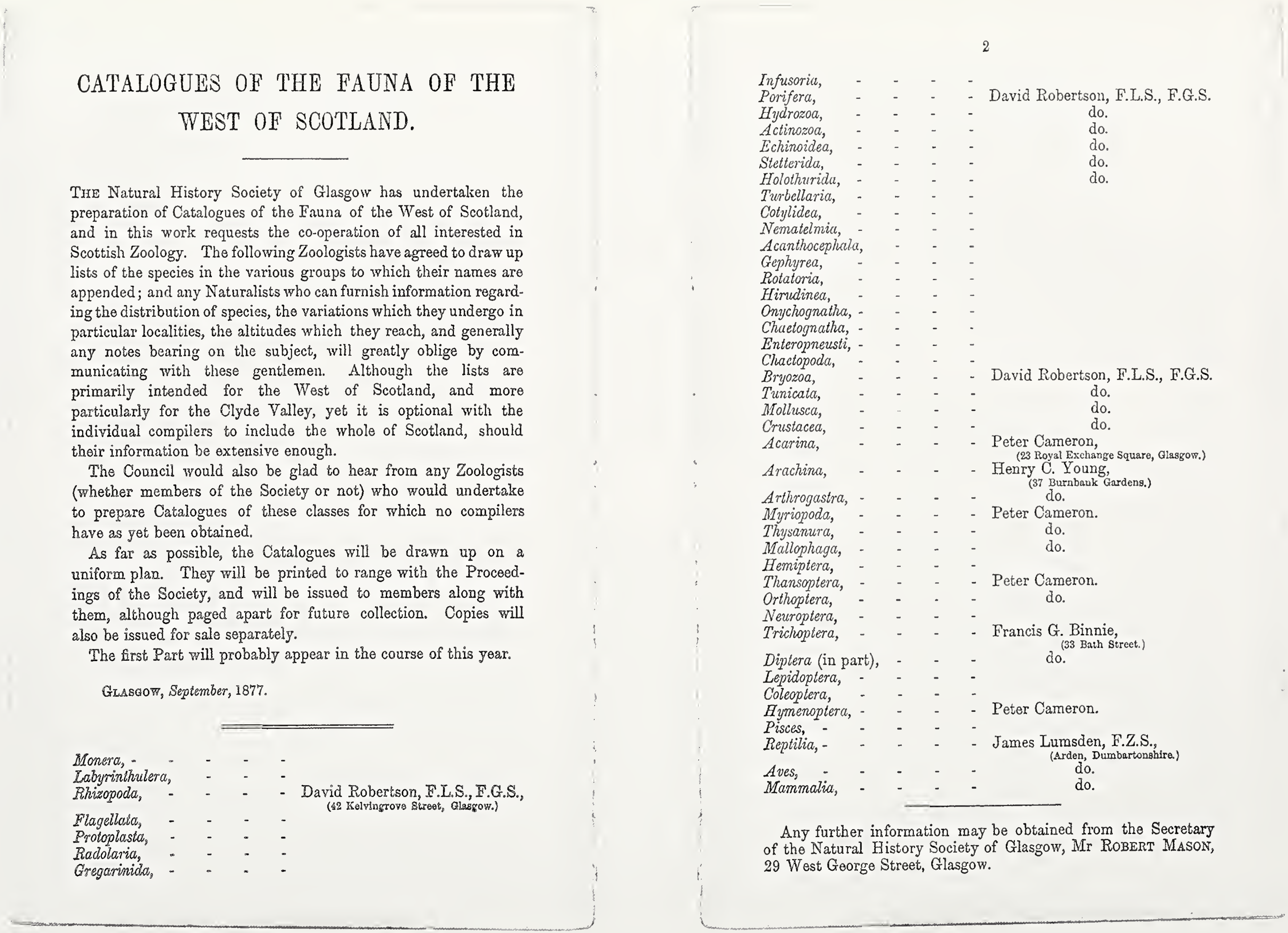
Clearly stimulated by this 1876 publication, one year later the Natural History Society of Glasgow embarked on a much more ambitious project, the aim of which was "the preparation of Catalogues of the Fauna of the West of Scotland". This was first advertised in a separate leaflet (now rare), dated September 1877, enclosed with (but not part of) Volume 3, part 2 of the N.H.S.G. *Proceedings*, and the project was reported to the 28th Annual General Meeting of the Society on 25th September 1877 (*Proceedings*, Vol. 3, part 3, page 222).

At this Annual General Meeting it was announced that "the compilation of lists of the Fauna of the Clyde valley should be taken up without further delay, the Flora of the district having been efficiently catalogued by Mr. R. Hennedy and other botanists", and (later) at the time of the amalgamation of the Glasgow Society of Field Naturalists, "the Field Naturalists having given considerable attention to the study of Botany, a department of Natural History which has not for some time been so prominent at the meetings of this Society as it deserves" (*Proceedings*, 4: 116).

The original 1877 leaflet (Figure 1) contained no less than 48 sections of vertebrate and invertebrate zoology which the Society eventually expected to publish, and prospective authors were announced for 25 of these sections. The authors were well-established authorities, who usually had already published, sometimes extensively, on their subjects, and originally included Francis G. Binnie, Peter Cameron, James Lumsden, David Robertson, and Henry C. Young; David Robertson was announced as prospective author for no less than eleven subjects. Later E.R. Alston was added to the list of authors, and later still J.M. Campbell and J.J. King. There were also some changes in authors and subjects; for example, E.R. Alston taking over mammals from James Lumsden, and later J.M. Campbell (after Alston's permanent removal to London) taking over reptiles and amphibians from Alston.

THE FAUNA OF SCOTLAND

As can be seen from the original 1877 leaflet, the project was first called 'Catalogues of the Fauna of the West of Scotland', and the lists were



CATALOGUES OF THE FAUNA OF THE WEST OF SCOTLAND.

THE Natural History Society of Glasgow has undertaken the preparation of Catalogues of the Fauna of the West of Scotland, and in this work requests the co-operation of all interested in Scottish Zoology. The following Zoologists have agreed to draw up lists of the species in the various groups to which their names are appended; and any Naturalists who can furnish information regarding the distribution of species, the variations which they undergo in particular localities, the altitudes which they reach, and generally any notes bearing on the subject, will greatly oblige by communicating with these gentlemen. Although the lists are primarily intended for the West of Scotland, and more particularly for the Clyde Valley, yet it is optional with the individual compilers to include the whole of Scotland, should their information be extensive enough.

The Council would also be glad to hear from any Zoologists (whether members of the Society or not) who would undertake to prepare Catalogues of these classes for which no compilers have as yet been obtained.

As far as possible, the Catalogues will be drawn up on a uniform plan. They will be printed to range with the Proceedings of the Society, and will be issued to members along with them, although paged apart for future collection. Copies will also be issued for sale separately.

The first Part will probably appear in the course of this year.

GLASGOW, *September*, 1877.

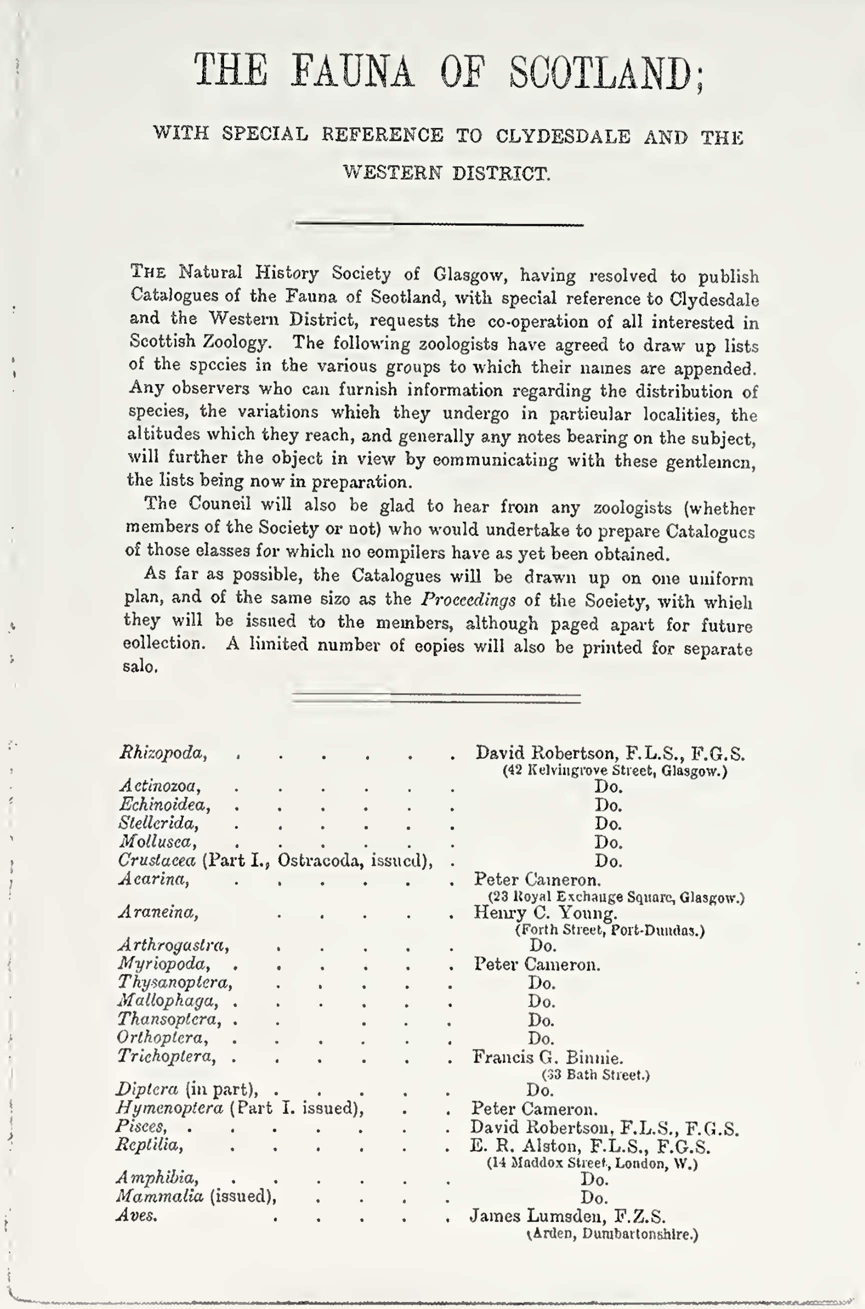
Monera,	
Labyrinthulera,	
Rhizopoda,	David Robertson, F.L.S., F.G.S., (42 Kelvingrove Street, Glasgow.)
Flagellata,	
Protoplasta,	
Radolaria,	
Gregarinida,	

2

Infusoria,	
Porifera,	David Robertson, F.L.S., F.G.S.
Hydrozoa,	do.
Actinozoa,	do.
Echinoidea,	do.
Stetterida,	do.
Holothurida,	do.
Turbellaria,	
Cotylidea,	
Nematelmia,	
Acanthocephala,	
Gephyrea,	
Rotatoria,	
Hirudinea,	
Onychognatha,	
Chaetognatha,	
Enteropneusti,	
Chaetopoda,	
Bryozoa,	David Robertson, F.L.S., F.G.S.
Tunicata,	do.
Mollusca,	do.
Crustacea,	do.
Acarina,	Peter Cameron, (23 Royal Exchange Square, Glasgow.)
Arachina,	Henry C. Young, (37 Burnbauk Gardens.)
Arthrogastra,	do.
Myriopoda,	Peter Cameron.
Thysanura,	do.
Mallophaga,	do.
Hemiptera,	
Thansoptera,	Peter Cameron.
Orthoptera,	do.
Neuroptera,	
Trichoptera,	Francis G. Binnie, (33 Bath Street.)
Diptera (in part),	do.
Lepidoptera,	
Coleoptera,	
Hymenoptera,	Peter Cameron.
Pisces,	
Reptilia,	James Lumsden, F.Z.S., (Arden, Dumbartonshire.)
Aves,	do.
Mammalia,	do.

Any further information may be obtained from the Secretary of the Natural History Society of Glasgow, Mr ROBERT MASON, 29 West George Street, Glasgow.

Fig. 1 The original 1877 leaflet outlining the plan for the *Fauna of Scotland* series.



THE FAUNA OF SCOTLAND;

WITH SPECIAL REFERENCE TO CLYDESDALE AND THE WESTERN DISTRICT.

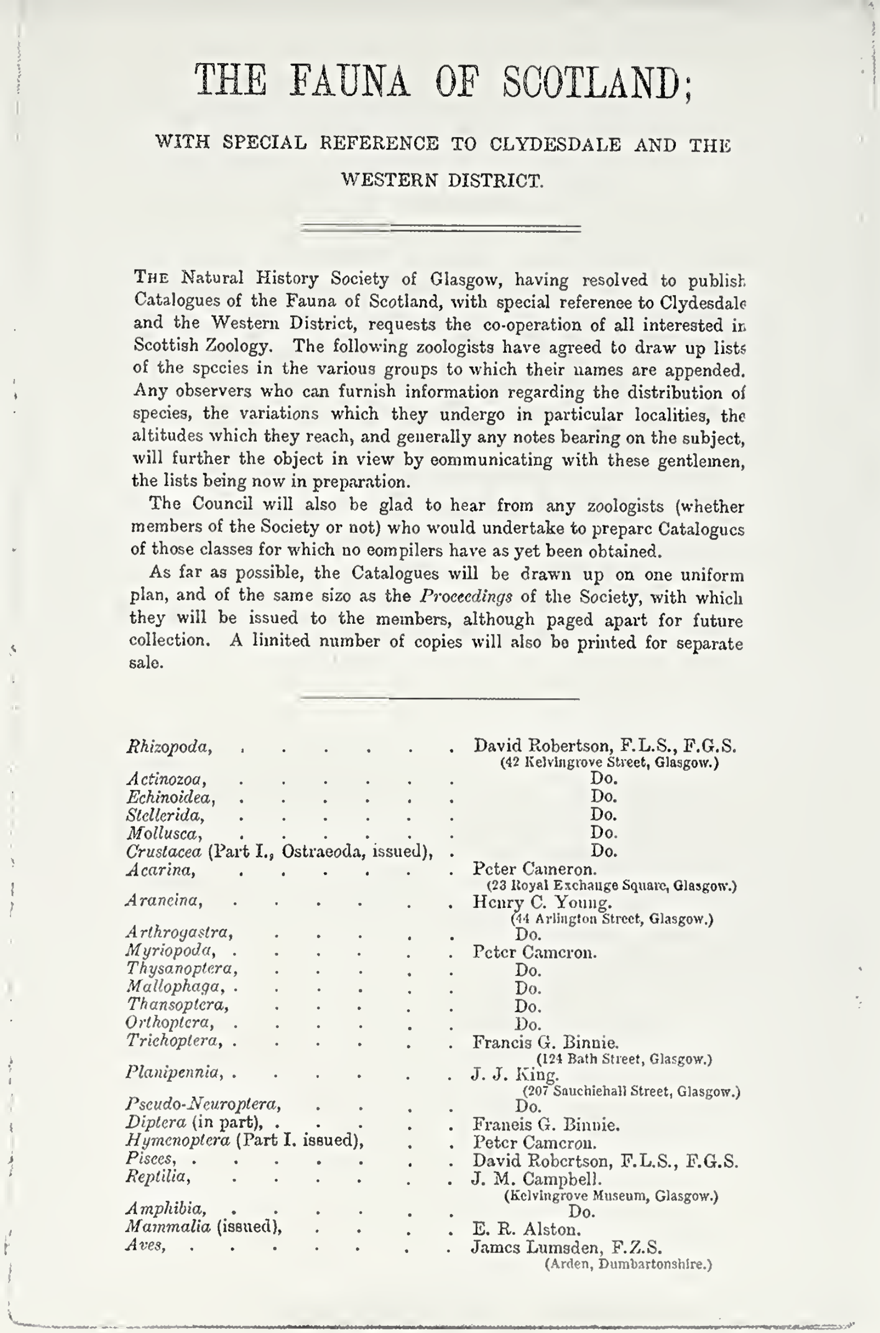
THE Natural History Society of Glasgow, having resolved to publish Catalogues of the Fauna of Scotland, with special reference to Clydesdale and the Western District, requests the co-operation of all interested in Scottish Zoology. The following zoologists have agreed to draw up lists of the species in the various groups to which their names are appended. Any observers who can furnish information regarding the distribution of species, the variations which they undergo in particular localities, the altitudes which they reach, and generally any notes bearing on the subject, will further the object in view by communicating with these gentlemen, the lists being now in preparation.

The Council will also be glad to hear from any zoologists (whether members of the Society or not) who would undertake to prepare Catalogues of those classes for which no compilers have as yet been obtained.

As far as possible, the Catalogues will be drawn up on one uniform plan, and of the same size as the *Proceedings* of the Society, with which they will be issued to the members, although paged apart for future collection. A limited number of copies will also be printed for separate sale.

Rhizopoda, ...	David Robertson, F.L.S., F.G.S. (42 Kelvingrove Street, Glasgow.)
Actinozoa, ...	Do.
Echinoidea, ...	Do.
Stellerida, ...	Do.
Mollusca, ...	Do.
Crustacea (Part I., Ostracoda, issued), .	Do.
Acarina, ...	Peter Cameron. (23 Royal Exchange Square, Glasgow.)
Araneina, ...	Henry C. Young. (Forth Street, Port-Dundas.)
Arthrogastra, ...	Do.
Myriopoda, ...	Peter Cameron.
Thysanoptera, ...	Do.
Mallophaga, ...	Do.
Thansoptera, ...	Do.
Orthoptera, ...	Do.
Trichoptera, ...	Francis G. Binnie. (53 Bath Street.)
Diptera (in part), ...	Do.
Hymenoptera (Part I. issued), . .	Peter Cameron.
Pisces, ...	David Robertson, F.L.S., F.G.S.
Reptilia, ...	E. R. Alston, F.L.S., F.G.S. (14 Maddox Street, London, W.)
Amphibia, ...	Do.
Mammalia (issued), ...	Do.
Aves.	James Lumsden, F.Z.S. (Arden, Dumbartonshire.)

Fig. 2 The revised (1880) plan for the *Fauna of Scotland* series.



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Rhizopoda, ...	David Robertson, F.L.S., F.G.S. (42 Kelvingrove Street, Glasgow.)
Actinozoa, ...	Do.
Echinoidea, ...	Do.
Stellerida, ...	Do.
Mollusca, ...	Do.
Crustacea (Part I., Ostracoda, issued), .	Do.
Acarina, ...	Peter Cameron. (23 Royal Exchange Square, Glasgow.)
Araneina, ...	Henry C. Young. (44 Arlington Street, Glasgow.)
Arthrogastra, ...	Do.
Myriopoda, ...	Peter Cameron.
Thysanoptera, ...	Do.
Mallophaga, ...	Do.
Thansoptera, ...	Do.
Orthoptera, ...	Do.
Trichoptera, ...	Francis G. Binnie. (124 Bath Street, Glasgow.)
Planipennia, ...	J. J. King. (207 Sauchiehall Street, Glasgow.)
Pseudo-Neuroptera, ...	Do.
Diptera (in part), ...	Francis G. Binnie.
Hymenoptera (Part I. issued), . .	Peter Cameron.
Pisces, ...	David Robertson, F.L.S., F.G.S.
Reptilia, ...	J. M. Campbell. (Kelvingrove Museum, Glasgow.)
Amphibia, ...	Do.
Mammalia (issued), ...	E. R. Alston.
Aves, ...	James Lumsden, F.Z.S. (Arden, Dumbartonshire.)

Fig. 3 The further (1881) plan for the *Fauna of Scotland* series.

"primarily intended for the West of Scotland, and more particularly the Clyde Valley, yet it is optional with the individual compilers to include the whole of Scotland, should their information be extensive enough". One year later, however, the project had been somewhat ambitiously renamed 'The Fauna of Scotland; with special reference to Clydesdale and the Western District'. Nevertheless, by far the greatest part of the information, contained in the four parts eventually published, concerns status and distribution within the Clyde area, which is perfectly understandable, and since then these Fauna of Scotland publications have usually, and correctly, been regarded as important primary contributions to Clyde natural history.

Like so many similar ideas, however, the original ambitious and laudable project eventually ground to a halt, and, in the event, only four parts of the Fauna of Scotland series were ever published. It is difficult to understand why no others were completed; the chosen authors were prominent and well-qualified naturalists of their day, who knew their subjects well and already had sound records of publication, sometimes extensively so, and the facilities for ready publication were in place and easily available. Clearly there was considerable initial enthusiasm, and the project got off to a flying start, but as is so often the case, the initial impetus was lost and ultimately simply petered out.

The slackening of momentum was obvious. In the original 1877 leaflet announcing the project, 48 subjects were listed, but by the time of the advertisements which appeared in the *Proceedings* of 1880 (Vol. 4, part 1) and 1881 (Vol. 4, part 2), the number of proposed subjects had been reduced to just over 20 (Figures 2 and 3). The comments on the development of the project are also illuminating; in 1877 some of the lists were "already in a state of forwardness", in 1878 and 1880 various other lists were "nearly ready for publication", but by 1881 they were merely "preparing for publication", and this continued to be the description printed until 1889, after which no more was heard about other parts being forthcoming.

With regard to the four parts which did actually appear, these were all first published as separately-paged supplements to the Natural History Society of Glasgow's *Proceedings* (but not always listed in the Tables of Contents) and were later issued for sale separately, although unfortunately these parts for re-sale gave no indication that they had originally been published as part of the *Proceedings*, an omission which has sometimes caused confusion in subsequent lists of references. The Scottish Natural History Library possesses both original and re-sale forms, and the full publication details are given in Table 1.

TABLE 1

Published parts of the Fauna of Scotland series

All parts were issued with the preliminary title of

The Fauna of Scotland
with special reference to
Clydesdale
and the
Western District

Peter Cameron (1878). Hymenoptera. Part 1. *Proceedings of the Natural History Society of Glasgow,* **3** (Part 3, supplement): 1-52. Issued for re-sale in the same year (1878) at 1/6d.

Edward R. Alston (1880). Mammalia. *Proceedings of the Natural History Society of Glasgow,* **4** (Part 1, supplement): 1-39. Issued for re-sale in the same year (1880) at 1/6d.

David Robertson (1880). Fresh and Brackish-water Ostracoda. *Proceedings of the Natural History Society of Glasgow,* **4** (Part 1, supplement): 1-35. Issued for re-sale in the same year (1880) at 1/6d. This part was advertised as 'Crustacea Part 1 - Ostracoda', but the actual title on the title-page is as given above.

Peter Cameron (1886). Hymenoptera. Part 2. *Proceedings and Transactions of the Natural History Society of Glasgow,* **1**(NS) (Part 2, supplement): 1-95. Issued for re-sale in the same year (1886) at 1/6d.

THE 1901 B.A. HANDBOOK

Although the original Fauna of Scotland series ultimately ceased almost before it had got properly started, the actual parts which were, in fact, eventually published are very useful pioneer accounts of Clyde natural history, and should be respected as such. In addition, much of the basic work done for the unpublished subjects in the series was certainly later used, or acted as the springboard for, the truly remarkable Handbook issued for the 1901 Glasgow meeting of the British Association. There is no doubt that, had it not been for the pioneer work undertaken for the old Fauna of Scotland series, the 1901 British Association Handbook on the 'Fauna, Flora and Geology of the Clyde Area', which formed such a sound and excellent platform for future research, would either not have appeared, or would have been infinitely less comprehensive.

The efforts of the Natural History Society of Glasgow in the late 1870s and early 1880s, even although they were only partly successful in their original aim, should therefore be given proper acknowledgement and acclaim.

GLASGOW NATURALIST Vol. 23 Part 6 pp 104-105 (2001)

NEARLY FIFTY YEARS AGO: MEETING BLODWEN LLOYD, JOHN LEE AND OTHER PROMINENT BOTANISTS IN THE SOCIETY IN 1954-55

JAMES H. DICKSON
Institute of Biomedical and Life Sciences, Division of Environmental and Evolutionary Biology, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ

In 1954 I was a sixth form pupil at Bellahouston Senior Secondary School and already wishing to study botany at Glasgow University. In those days the Royal College of Science and Technology (yet to become Strathclyde University in the 1960s) gave Christmas lectures for school pupils and one of the audience had to give the vote of thanks and I had been chosen in advance. Blodwen Lloyd was the head of biology, she was the chairperson and so I met her. She was the first professional botanist I ever met and it was an encouraging experience. She asked me if I would like to see the herbarium which had many specimens collected by John Scouler, who was the third president of our society and a plant collector in the Pacific Northwest of America in the early 19th century. Blodwen took a friendly interest in me and was very pleased when I paid a second visit to the herbarium. I do not remember precisely what I did on that brief second visit and so it cannot have been all that exciting. However, from then on Blodwen and I were a mutual congratulation society. Though we did meet rarely, for instance, in Seattle at the International Botanical Congress, our paths did not cross much thereafter till I returned to Glasgow from Cambridge in 1970.

The next botanist to take an interest in me was Basil Ribbons who had been a lecturer in Glasgow University since 1949. Basil was trying to recruit members for the Botanical Society of the British Isles and he informed Glasgow schools of excursions and I went along on 15th May 1955 to Flanders Moss, the large raised bog in the upper Forth Valley, which from then on became one of my happy hunting grounds. Indeed, before I left Glasgow in the autumn of 1959 I helped Judith Turner to collect peat samples there for her pollen analytic research. Her pollen diagram became one of the very first detailed diagrams from Britain to show the long-term effects of prehistoric people on vegetation. Also in the spring of 1955, I went on Basil's extramural excursion to Tilletudlem Castle where we saw Greater Celandine; it was a very appropriate place for this ancient introduction to be found.

Through Basil I got to know of the Glasgow and Andersonian Natural History and Microscopical Society, as our society was then cumbersomely known. That summer I attended two excursions before joining the society in October 1955. In August I was part of the party going to Lochwinnoch. Richard, Dick as he was known to all, Prasher was there and so was John Lee, who had joined the society in 1885. John Leee was 87 and I was 18 when we met. By that time I had bought, in the now defunct John Smiths in St Vincent Street, his *Flora of the Clyde Area* published in 1933 but still in print. So I knew very well who he was. He was a very kindly, old Victorian gentleman and certainly the first author I had knowingly ever met. My copy of the *Flora* is heavily annotated in pencil with localities, dates and comments. In those days books were very precious to me, as indeed they still are: I never wrote on them in ink and many new purchases were given brown paper wrappings immediately.

So I had the pleasure of being in the field with John Lee and we saw, among others, Broad-leaved Helleborine and the plant well-known at Lochside Station *Aster longifolius*. He and I travelled back to Glasgow by train and it would have been then, as I mentioned in *Wild Plants of Glasgow*, that he told me about Rose-bay Willowherb having been a rarity when he was a young man, many decades previously. We discussed plants of railways and he mentioned Sticky Groundsel, as though it was something of a rarity, and I remember, when the train was briefly stationary outside Paisley, looking out and seeing it on the track below. Though he was a very pleasant, polite gentleman, his age and status made me in awe of him and I did not feel able to tell him that it was not rare at all, as was the case. Also that summer I joined the trip to Braidwood in the upper Clyde Valley where there are botanically rich woodlands. We saw Herb Paris, as I seem to remember. John Lee was there too but he did not feel able to descend into the steep valley. These were the only two excursions we were ever on together.

On 12th October that year I was elected to the Society at the ordinary meeting which was held, as all the others were then, in the same room in the main building of the Royal College. John Lee was not there but someone told me he had been ill and had been asking after me. I was so pleased to have been so told, that on the back flyleaf of the *Flora*, I made a special note, which now seems somewhat embarrassingly precious. I did not see much of John Lee thereafter but I remember resistance from him late in 1956 at the meeting which changed the name of the Society to the Andersonian Naturalists of Glasgow. Finally, I attended his 90th birthday tea party. Much revered by society members, sadly John Lee died shortly afterwards.

Having joined the society in 1936 Dick Prasher was one of those who was closest to John Lee. He had been a railway man and was a keen field botanist and very public spirited. The award of an M.B.E in the 1970s gave him the greatest pleasure. In 1955. I learned much field botany from him because I joined the various excursions he led to places such as Possil Marsh and Monkton on the Ayrshire coast.

I met Alfred Slack, Alf as he was known to all, at one of the first meetings I attended of the Society. Having been on a school summer trip to Golspie in Sutherland in July 1955, I had collected some specimens including Mountain Bearberry from Ben Horn. Alf noticed them when I put them on display at the meeting and he befriended me. Subsequently during my undergraduate career Alf and his wife Mattie took me on botanising jaunts round the Highlands. They were most enjoyable and formative occasions; I had never met a conscientious objector before nor vegetarians and so they were educative in more than the botanical sense.

Robert Mackechnie, or Bob as he was often called, was elected president of the Society at the meeting when I was admitted a member. In those days the Scottish Field Studies Association had its centre at Garth Youth Hostel near Fortingall in Perthshire. As many others did, I learned a lot from Bob when I attended his grasses, sedges and rushes course there in 1957. Through the good offices of Basil Ribbons, in the summer of 1958 I was the field studies assistant there.

For many years the Society's treasurer, Robert Johnstone was very keen on fungi. I went on the fungus forays he organised and learned to identify many mushrooms and toadstools from him. Indeed I was so keen a pupil that he thought I would become a mycologist and he was badly disappointed when that turned out not to be the case. During those undergraduate years I had a sponge-like capacity for acquiring botanical knowledge and really it was my aim to get to know any and every plant and fungus that I encountered.

Alan Crundwell had joined the Botany Department at the same time as Basil Ribbons. He had a very good knowledge of the British flora, especially mosses and liverworts. I naturally gravitated to any teacher who knew more than me and from whom I could learn a good deal of field botany. Alan encouraged me to study bryophytes and consequently, with his support and that of his friend E.F.Warburg of Oxford, I went to Cambridge to produce a Ph.D. thesis on Ice Age bryophytes and ultimately the book *Bryophytes of the Pleistocene.*

To all these members of our Society I am very grateful for their kindliness, the transfer of knowledge and good company over many years. All but one have now passed away but I like to think that had they been still alive they would all have enjoyed the just published *The Changing Flora of Glasgow* which I have written with Peter Macpherson and Keith Watson.

GLASGOW NATURALIST Vol. 23 Part 6 pp106-110 (2001)

PROMINENT GLASGOW NATURAL HISTORY SOCIETY ZOOLOGISTS

RONALD M. DOBSON
7 Netherburn Avenue, Glasgow G44 3UF
(with a note by E.G. Hancock)

"Though from the beginning much of its best work was done by amateurs, it nevertheless received recognition by men of professional standing; and from early days the University seems to have realised the importance of the work being done. This happy association between those actively engaged in teaching and research in the natural sciences and the 'field naturalists' to whom the outer world made irresistible appeal has all along continued a characteristic of the Society, and is indeed one of its most valuable and cherished features". In these words the well-known and much respected amateur botanist, the late John R. Lee, a past president, succinctly conveyed the spirit and character of the Society on the occasion of the centenary celebrations in 1951. It is true to say that even after the passage of a further 50 years and the great emphasis now placed on analytical approaches such as molecular biology and biochemistry Lee's words still apply and there remains a close rapport between the professionals and amateurs in numerous fields of discipline.

The present society, was formed in 1931 as an amalgam of three earlier societies, the *Natural History Society of Glasgow* (founded 1851 and here abbreviated to *NHSG*), the *Andersonian Naturalists' Society (ANS* founded 1885) and the *Microscopical Society of Glasgow (MSG*, founded 1886). At first known as the *Glasgow and Andersonian Natural History and Microscopical Society*, later shortened to the *Andersonian Naturalists of Glasgow*, the present name, the *Glasgow Natural History Society* (*GNHS*) was adopted in 1979. *NHSG* had its own journal, the *Proceedings of the Natural History Society of Glasgow* (1858-1883) (*Proc.*), succeeded by the *Proceedings and Transactions of the Natural History Society of Glasgow* (*New Series*) (1883-1908) (*Proc. & Trans*) and finally by the *Glasgow Naturalist* (1908 onwards) (*G. Nat*) *ANS* had its own journal *The Annals of the Andersonian Naturalists' Society* (1914-1925) (*Ann.*).

Throughout its history the membership of the Society has been favoured with an impressive succession of distinguished zoologists. Many served on the Council, held office, published in its journals, attended meetings, ran excursions and / or were involved in various other activities. Others, often living furth of Glasgow, or corresponding members, had little involvement but nevertheless were sympathetic to the aims of the Society and by their work helped to set standards which were an inspiration to all. In a short biographical account, such as this, it is impossible to pay due homage to all of these, so some selection had to be made. Thus only those who actively contributed to the work of the Society are included even though this meant cutting out some famous names that appeared on the membership lists.

The Rev. David Landsborough, (died 1854), was a distinguished early member with wide interests, not only in zoology, but also in botany, geology, palaeontology and archaeology. He produced many publications amongst which was the *Popular History of British Zoophytes* (Corals, Sponges etc.). His son, also the Rev. David Landsborough (1826-1912), became a corresponding member of *NHSG* in 1887 and at first worked with his father but later became a distinguished marine zoologist with particular interests in molluscs and zoophytes. He produced numerous publications some of which appeared in *Proc. & Trans.* The nudibranch mollusc, *Eolis landsburgii*, was named in his honour.

Still within the field of marine zoology, David Robertson, LL.D., F.L.S., F.G.S. (1806-96) joined *NHSG* in 1852 and was president 1887-90. A largely self-taught man, as a boy and youth he worked in various manual, mainly farming jobs but attended night school from the age of 21. He became a medical student but discontinued before taking his final examinations and set up a pottery warehouse which he ran until 1860. Interested in natural history from an early age, after retirement he was able to devote his whole attention to it and settled in Millport where he collected, observed and described animals caught on the shore and dredged from the bottom. While there he entertained a young German, Anton Dohrn, who later founded the zoological station at Naples, and his influence helped in the establishment of this organisation. In 1884 the Marine Station at Granton had been established and preliminary surveys of the Clyde estuary indicated the desirability of setting up a Clyde branch of the Scottish Marine Station. Millport proved to be an ideal location and as a preliminary step an old barge, the *Ark* which had been set up as a floating laboratory was brought from Granton and beached there. Robertson was much involved with this and worked towards the establishment of a permanent building suitable for a marine station. His ambition was realised in

1896 when building commenced, but unfortunately he died a month later. Amongst his many publications some 70 appeared in *Proc.* and *Proc. & Trans.* and the dredge he invented is described and illustrated in *Proc.* I (1858-69).

Edgar A. Smith (1847-1916), an eminent conchologist, was an assistant keeper in Zoology at the British Museum. He became a corresponding member of *NHSG* in 1888, was for a time president of the Conchological Society of Great Britain and Ireland and was a founder member and later president of the Malacological Society of London whose *Proceedings* he edited until shortly before his death. He was largely responsible for building up the magnificent collection of shells at the museum and wrote a monograph on the bivalve molluscs obtained during the cruise of the H.M.S. *Challenger* (1872-86), the reports of which laid down the foundations of the modern science of oceanography. In all he produced some 300 papers on Mollusca as well as a few on echinoderms. His contribution to science was recognised by his being awarded The Imperial Service Order during the reign of King Edward VII.

Sir D'Arcy Wentworth Thompson, C.B., F.R.S., F.R.S.E., D.Litt., (1860-1948), a corresponding member from 1887, was one of the giants of zoology during the last years of the 19th and the first half of the 20th centuries. In 1884 he was appointed Professor of Natural History at University College, Dundee, where amongst many other activities he founded the Museum of Biology, then in 1917 he moved to a similar post at St. Andrews. Always interested in marine biology he served on the Fishery Board for Scotland from 1897 until 1939 and produced many papers on fisheries and oceanography. In 1888 he addressed the Society on 'Museum methods' expressing the view that many natural history collections were mere store-houses of specimens and that "to enable the educative value of such collections to be fully realised, the specimens should be so arranged as to afford a view of the life-history of each group". His greatest work was the monumental book *On Growth and Form* (1917), in which he explored the extent to which the form of living things could be interpreted in terms of the physical forces acting on them during their lifetime. He was a fine teacher, and in the words of one of his students "you didn't only learn about zoology, you were educated". He was fluent in French and was an accomplished classical scholar producing A *Glossary of Greek Birds* (1895) and *A Glossary of Greek Fishes* (1945).

Sir John Graham Kerr, M.A., LL.D., F.R.S., F.R.S.E. (1869-1957) joined the Society as an Ordinary Member in 1902 but later was elected Honorary Member. As Regius Professor of Natural History, later Zoology, at Glasgow University (1902-35) he completed the fine Zoology building (now named after him) with its museum in 1923. He was mainly interested in morphology and embryology but was also deeply concerned with marine biology and was a member of the Advisory Committee on Fishery Research being chairman from 1942 until 1949. He was critical of the running of the Marine Station at Millport in its early days believing that it should undertake a continuous programme of research and recording, after the manner of the Naples Laboratory, and that its staff should liaise freely with both amateur and professional biologists. Later he devoted much time to the organisation of this station and was president of the Scottish Marine Biological Station from 1942 until 1949. In 1930 he was one of a group of biologists who sought to acquire Possil Loch as a bird sanctuary and was involved in setting up the Scottish Wild Birds Sanctuary Trust. He was interested in the application of correct biological principles to working out a system of camouflage involving the use of obliterative shading and disruption to render ships less conspicuous in time of war and approached the Admiralty in 1914 to advocate the use of such methods. After some mistakes his ideas were adopted and were even extended to land installations during the Second World War. He published the textbook *A Zoology for Medical Students* (1921) as well as many papers in national and local periodicals including *Proc. & Trans.* and *G. Nat*. One paper of particular interest in *G. Nat.* II (1910) includes a list of the type specimens of over 200 species of insects described by J.C. Fabricius and 21 corals described by Ellis which are lodged in the Hunterian Museum at Glasgow University. He edited *Glasgow, 1928*, a handbook issued in connection with the British Association (B.A.) meeting at Glasgow in 1928, and occasionally lectured or exhibited specimens at meetings of the Society. He received many honours including the Linnean Gold Medal in 1955.

Sir C. Maurice Yonge, C.B.E., Ph.D., D.Sc., F.R.S.E., F.R.S, (1899-1986) was Regius Professor of Zoology at Glasgow from 1944-64 after being, from 1932 to 1944, the first Professor of Zoology at the University of Bristol. He joined the Society as an ordinary member in 1945 and gave several lectures at meetings. He was a distinguished marine zoologist being a leading authority on molluscs and the biology of coral reefs. He organised the Great Barrier Reef Expedition of 1928-29, subsequently writing the book *A Year on the Great Barrier Reef: the story of corals and of the greatest of their creations* (1930). He wrote the New Naturalist volumes *The Sea Shore* (1949) and *Oysters* (1960) and in collaboration with F.S. Russell, *The Seas* (1928) and with J. Barrett, the handbook *British Marine Life* (1944) as well as a large number of papers in scientific journals. Sir Maurice also served on various fisheries advisory committees and was elected to honorary membership and honorary offices in at least nine scientific and marine societies and associations. In 1957 he received the Mackdougall-Brisbane Prize of the

Royal Society of Edinburgh and in 1968 the Darwin Medal of the Royal Society. He also held honorary D.Sc degrees from four British Universities.

James Fairlie Gemmill, M.A., M.D., D.Sc., F.R.S. (1867-1926) joined the Society in 1898 and served as councillor, vice-president and president. His interests were in medicine and biology and in 1906 he was appointed first as Lecturer, and later in 1918, as a Research Fellow in Embryology at Glasgow University, where the only previous Research Fellow had been Lord Kelvin (also a member of the Society). He spent much time working at Millport and was the first president of the Marine Biological Association of the West of Scotland. He made many communications to the Society including several articles on marine organisms in *Proc. & Trans.* Of unusual interest is a small volume *Natural History in the Poetry of Robert Burns* which was edited from the manuscript of an undelivered lecture found posthumously amongst his papers and published by his brother in 1928. Dr. Gemmill left Glasgow in 1919 when he was appointed Professor of Natural History at University College, Dundee and on the occasion of this the distinguished zoologist Professor E. W. MacBride of Imperial College, London said "I know of no more brilliant researcher at present living in the United Kingdom, so far as Zoology is concerned"..

Turning now to studies of vertebrates, the contribution of Robert Gray, F.R.S.E., (1825-87) must be considered. Gray was present at the original meeting in 1851 when it was decided to form the Society and, a banker by profession, he became a distinguished ornithologist. For many years he was a frequent contributor to *Proc.* and he served as Treasurer (1854-56), Secretary (1858-71) and Councillor (1871). He was elected an Honorary Member in 1877. He also held offices in the Royal Society of Edinburgh and the Royal Physical Society and was a prominent member of the Botanical Society of Edinburgh. His book *The Birds of the West of Scotland* (1871) was a classic for its day.

John A. Harvie-Brown, F.R.S.E.., F.Z.S. (1844-1916) was a distinguished vertebrate zoologist who joined the Society in 1866, was President 1882-83 and was elected an Honorary Member in 1901. He published a variety of papers on mammals and birds and made several contributions to *Proc.* and *Proc. & Trans.* He was best known for his *A Vertebrate Fauna of* --- series of books published alone or jointly. Areas covered were --- *Sutherland, Caithness and West Cromarty* (1887), --- *the Outer Hebrides* (1888), --- *the Orkney Islands* (1891), --- *Argyll and the Inner Hebrides* (1892), --- *the Moray Basin* (1895) and --- *the North-west Highlands and Skye* (1904).

Hugh Boyd Watt, F.Z.S., M.B.O.U., (died 1941), was an original member of *ANG* (1885) and joined *NHSG* in 1896. An underwriter by profession his chief natural history interests were birds, mammals and ancient Scottish woodlands and he was active in the Clyde area before leaving for London where his interests were maintained. Before leaving he published papers on heronries, rookeries and on both land and sea mammals in *Proc. & Trans.* and papers on The Return of the Swallow' and on Scottish Forests and Woodlands in Early Historic Times' in *Ann.* He wrote the section on 'Mammalia' in the Handbook, *Fauna, Flora and Geology of the Clyde Area* produced for the *B.A.* meeting in Glasgow (1901) and with John Paterson and John Smith 'The Natural History of Ailsa Craig' which appeared in *Ann.*

Alexander Ross, F.E.I.S., (1857-1940), was headmaster of a Glasgow school who joined both *ANS* and *NHGS* in 1894. In *ANS* he immediately became Joint Honorary Secretary and later convener of the Entomological Section and a member of the Publications and Library Committee. In NHSG he served on the Council and became Joint Honorary Secretary in 1903, a post he held for 18 years. He was President 1920-23 and Joint Editor 1926-35. His interests were ornithology and entomology, especially Diptera and he made numerous contributions by exhibiting specimens and presenting papers at meetings of the Society. He wrote 'The Birds of Islay', Some Additional Notes on the Birds of Islay' and 'The Summer Birds about Tarbert, Loch Fyne' for *G. Nat.* and was involved in the planning of the Clyde Card Catalogue prepared for the B.A. visit to Glasgow in 1928. It was his motion that led to the transfer of the Society's library to the Mitchell Library and he supported the amalgamation of the three societies in 1931.

One of the great strengths of the Society has always been entomology and many prominent entomologists have appeared amongst its ranks. James Joseph Francis-Xavier King, F.E.S., (1855-1933) joined *NHSG* in 1872 when he was about sixteen years old and was librarian for several years from 1883 becoming Vice-president in 1921 and finally an Honorary Member in 1928. He also joined *ANG* in 1890 where he held office on the Council. An artist by profession he was a teacher and later Librarian at the Glasgow Art School but he also lectured on Insect Economics at the Glasgow Technical College and clearly his first love was entomology. He spoke at and exhibited specimens at meetings frequently from 1873 until 1930 and published numerous notes and papers on Scottish and Irish insects in *Proc., Proc. & Trans.*, and *G. Nat.* as well as contributing the sections on Microlepidoptera, Trichoptera, Odonata, Orthoptera and Neuroptera-Plannipennia to the *B.A.* Handbook of 1901. He was an extremely ardent collector and filled numerous cabinet drawers and large numbers of cigar boxes with tightly packed, pinned specimens each bearing a label with the place of origin and the date. These huge collections, estimated to contain some half a million specimens, were donated to the Hunterian Museum at Glasgow University where many have still to be sorted and identified.

Another ardent insect collector was Anderson A. Fergusson, F.E.S. (1877?-1949), who first joined NHGS in 1888, served on the Council in 1918 and 1922 and was President 1929-30. He was interested in Coleoptera, frequently exhibiting specimens at meetings and contributed numerous notes to *Proc. & Trans.* and *G. Nat.* He wrote the account of Coleoptera for the 1901 *B.A. Handbook* and followed this with supplements published in *G. Nat.* With Graham Kerr he was involved in setting up The Scottish Wild Birds Sanctuaries Trust. His collection of mainly Scottish Coleoptera was donated to the Hunterian Museum, and as with King's collection, although to a much less extent, a proportion of the specimens have still to be determined.

Robert Henderson (1864-1940), by profession foreign correspondent to an engineering firm, specialised in collecting Diptera. He was born in Tipperary and came to Glasgow about 1870, joining *ANS* in 1889 and *NHSG* in 1899. Serving on the *NHSG* council on several occasions he became Vice-president in 1918 and later served as Joint Auditor (1922-26). He wrote the section on crane-flies for the *B.A. Handbook*, (1901) and published three updated lists of the Clyde Diptera in *Proc. & Trans.* VII and VIII between 1904 and 1908. He also helped to compile the Clyde Card Index for the B.A. meeting of 1928. His extensive collection of British Diptera was bequeathed to the Hunterian Museum.

Leonard A. L. King, M.A., F.R.S.E., a professor at the West of Scotland College of Agriculture, joined *MSG* in 1904, became an Honorary Member in 1907 and was President 1909-30. He joined *NHSG* in 1906, was a member of the Zoology and Entomology sections, served on the Council, became Vice-president in 1923 and finally President 1934-36. He was the Society's representative to the Royal Philosophical Society of Glasgow in 1944 and was chairman of the committee which prepared the Clyde Card Catalogue in 1928. He had very wide interests ranging from leeches and sea-spiders to insects and birds. He contributed much to the work of the Society by lecturing, exhibiting specimens, by leading excursions and by publishing notes, obituaries etc. in *G. Nat.*

Iain Colin Christie, B.Sc., (1930-91), joined the Society in 1978, served on the Council 1980-82 and 1986-88, was Zoology Convener 1982-84 and Vice-president 1984-85. By profession a farmer, he had a deep and broad knowledge of natural history with a special interest in the Lepidoptera and he initiated the series of insect record papers published each year in *G. Nat.* which started as 'Lepidoptera in Strathclyde, 1983' but was gradually enlarged in scope until now all insects and the whole of Scotland are covered. From the start he took an active part in the affairs of the society by giving lectures, exhibiting specimens, reviewing books and publishing articles in *G. Nat.* His interests and detailed knowledge extended far beyond Entomology and included birds, mammals and plants. His last full paper was on the ericaceous plant *Ledum groenlandicum* Oeder on Flanders Moss.

Roy Albert Crowson, D.Sc., A.R.C.S., D.I.C. (1915-99), one of the most eminent coleopterists of all time, first joined the Society in 1951 and was Vice-president 1967-69. He participated in numerous excursions and published many papers in various journals including *G. Nat.*, as well as books on *Biology and Classification* (1970) and on the *The Biology of Coleoptera* (1977). In 1980 he was awarded the Gold Medal of the Linnean Society in recognition of his contribution and in 1994 a two-volume Festschrift, or celebratory collection of papers, entitled *Biology, Phylogeny* and *Classification of Coleoptera* was published in Warsaw to commemorate his 80th birthday. His pinned insects have been incorporated into the collection of Coleoptera at the Hunterian Museum. His collections of microscope slides and of material preserved in alcohol were bequeathed to the Natural History Museum, London.

W.D. Russell Hunter, B.Sc., Ph.D., D.Sc., F.I.Biol., F.L.S., F.G.S. joined the Society in 1948 and was very prominent in its affairs until 1963, when he was appointed to a professorial post in U.S.A. A specialist in fresh-water and marine littoral molluscs, he published over 120 papers either alone, or in partnership with his wife, Myra, and / or colleagues. Amongst papers in *G. Nat.* were studies of the structure and geology of the Garvelloch Islands and of their molluscs and birds. He served on the Council from 1952 and was Editor 1955-63. He was also the Society's representative to the Scottish Field Studies Association. Now living in retirement in the U.S.A. he still retains his membership of the Society.

Bernard Zonfrillo, Ph.D., joined the Society in 1969, served on the Council in 1972, was Ornithological Convener 1973-86 and Vice-president 1977-78 and 1985-87. Originally a quantity surveyor he turned to natural history and is not only a leading authority on birds but is also interested in Marine Biology, Entomology and Botany. He has lectured to the Society, led excursions and reviewed numerous books and, in addition to articles on birds, his numerous contributions to *G. Nat.* range from observations on Risso's Dolphin to notes on ferns, moths and butterflies. His paper 'The Flora of Ailsa Craig' (1994) is a major contribution to the knowledge of that island. In recognition of his work he has been awarded Honorary Research Associateships at both the Marine Station at Millport and at Glasgow University.

John A. Gibson, M.B., Ch.B., M.D., FRCGP, DObstRCOG, C.Biol., F.L.S., F.R.G.S., F.R.M.S., F.G.S., F.S.A.(Scot) is a family doctor who is also most active in natural history circles with special interests in the vertebrates. He joined the Society in 1951 and amongst many papers on natural history accounts of the 'Land Mammals of the Clyde Faunal Area' and of the 'Reptiles and Amphibia of the Clyde Faunal Area' were published in *G. Nat.* He has been editor of the Scottish Naturalist since 1972 and chairman of the Scottish Natural History Library since 1974. Dr. Gibson has held office in several natural history societies and was a recipient of the gold medal of The Society for the Protection of Birds in 1967 and of the Queen's Silver Jubilee Medal in 1977.

Edward Geoffrey Hancock, B.Sc., F.M.A., a taxonomic entomologist with particular interests in the Diptera joined the Society in 1985, became a councillor in 1987, Zoology Convener in 1988, President 1990-92 and Vice-president 1993-94. He has been much involved in the recent survey of the Glasgow Botanic Gardens by members of the Society and in dealing with the acquisition and storage of overseas exchanges in the library. With the aid of Heritage Lottery funding, along with Margaret Reilly of the Hunterian Museum, he has drastically improved the collections of pinned insects by using modern steel storage cabinets and arranging for the determination of unidentified material. He has lectured to the Society, arranged excursions, published papers and book reviews in *G. Nat.* and has continued the annual publication of 'Scottish Insect Records' initiated by Iain Christie.

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E.G. HANCOCK adds

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Ronald Matthew Dobson (b. 1925) became a member of the Society in 1963, after moving to a lectureship in 1959 at the University of Glasgow from Rothamsted Experimental Station, Hertfordshire. His career until then included employment at the Ministry of Food Infestation Division and Department of Agriculture for Seotland and had concentrated on economic aspects of entomology, initially in the beetle genus *Carpophilus* (Nitidulidae) on which 9 papers have appeared concerning their taxonomy and importance as pests of stored products. Numerous papers on agricultural pests have been published such as anthomyid Diptera (wheat bulb and root flies), tipulids (leatherjackets/craneflies) and chrysomelids (flea beetles), these last being the subject of his doctoral thesis from the University of London awarded in 1955. Much of the material which grew steadily from these studies has been deposited in the Hunterian Museum (Zoology). In addition numerous insects from faunistic surveys of Scottish localities, particularly from the Muck Islands and the Blackwood of Rannoch (*G. Nat.*) can be found in the museum. Many specimens from expeditions with students to South Uist and Portugal are in the collections of which Ron was an honorary curator. Since his retiral the museum has benefited also from much work on identifying backlogs of unidentified British beetles.

Within the Society he served as Editor (1984-1995), initially assistant editor from 1964, Vice-president (1976-78, 1991-93, 1995-97), Zoology convener (1972-81) and a council member on various occasions. He is probably one of the most regular meeting attenders along with his wife Ruth and he delivered lectures to the members. Ruth Dobson not only functioned as Society Librarian but shared interests in natural history have resulted in co-authoring or authoring many of the papers and short notes on the fauna and flora of Muck Islands and Ardnamurchan (*G. Nat.*). These papers were reprinted and sold to tourists in these areas boosting both the reputation and the income of the Society

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BEN LOMOND – 1900 AND 2000 : BOTANICAL RECORDING BY GLASGOW NATURALISTS, PAST AND PRESENT

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On 30 June 1900, a 'joint – excursion' of the Natural History Society of Glasgow, the Geological Society and the Edinburgh Field Naturalists and Microscopical Society was held. The list of the plants which were observed on the Ben appeared in the *Transactions of the Glasgow Society* (Table 1).

Table 1 Ben Lomond plants recorded in 1900, with altitudes

Habenaria conopsea (*Gymnadenea conopsea*)	fragrant orchid	
Myrica gale		
Listera cordata		183m
Thalictrum alpinum	alpine rue	384 – 884m
Rubus chamaemorus	cloudberry	580 – 640m
Gnaphalium supinum	dwarf cudweed	
Potentilla sibbaldi (*Sibbaldia procumbens*)	sibbaldia	
Armeria maritima	thrift	701 – 884m
Silene acaulis	moss campion	823 – 974m
Saxifraga nivalis	alpine saxifrage	from 854m
Luzula spicata	spiked woodrush	from 854m
Cochlearia alpina (*C. officinalis ssp alpina*)	scurvygrass	from 854m
Saxifraga rhodiola (*Sedum roseum*)	roseroot	from 854m
Saxifraga hypnoides	mossy saxifrage	from 854m
Saxifraga stellaris	starry saxifrage	580 – 974m
Phyopteris dryopteris (*Gymnocarpium dryopteris*)	oak fern	1189m!!
P.polypodioides (*Phegopteris connectilis*)	beech fern	183m
Polygonum viviparum (*Persicaria viviparum*)	alpine bistort	823m
Juncus triglumis		

Table 1 gives the modern scientific names in brackets. The editor of the transactions in 1900 was rather careless; as you can see, there are a number of errors. Roseroot has been wrongly identified as a saxifrage. Oak fern was known as *Phegopteris dryopteris*, not *Phyopteris*, and it certainly did not grow at 1,189m (3,900ft), since Ben Lomond is only 974m (3,192ft) high.

The records do not reveal the means of transport used by the party to reach the Ben. It is possible to speculate that they took the train from Glasgow to Balloch, and thence the steamer to the pier at Rowardennan. This would give a closer access to the mountain than an alternative route via train to Aberfoyle and horse-drawn charabanc to the Stronachlacher road and a long walk in. There are two main areas which support an 'alpine' flora on Ben Lomond; the west facing cliffs of the Ptarmigan ridge at 533–607m (1,750 to 2,000ft) and the northern corries from 762 – 914m (2,500 to 3,000ft). It is more likely that the 1900 party visited the northern corries because many of their sightings were at heights greater than the summit of Ptarmigan. From Rowardennan a possible route to the northern corries would have been from the hotel up to the main ridge leading to the summit and descend into the corrie just before the summit. The route from the east via Aberfoyle would have taken them to the north side of the Ben, to the farm of Comer, which gives good access to the northern corries.

In spite of our improved modern methods of transport, the 100th anniversary outing of the Glasgow Natural History Society to Ben Lomond on Saturday, 2nd July 2000 (Figs. 1 and 2) did not leave the Rowardennan car-park till 11am. This meant that we would be unlikely to visit both the northern corries and the Ptarmigan cliffs, so we opted for the latter. A full species list is given in Table 2. What follows is an account of some of our more notable finds.

A party of 8 members, including the President, Bob Gray, made their way up through oak woodland, on to the newly constructed path to the Ptarmigan ridge. This path, made by the National Trust for Scotland, who own the Ben, has been made necessary by the fencing off of a stretch of woodland near the waterfall, as part of an extensive programme of conservation being carried out by the Trust. Beyond the wood we passed through steep, bracken-covered slopes, then a flat area of bog with cotton grass, *Eriophorum angustifolium;*sundew, *Drosera rotundifolia* and heath spotted orchid, *Dactylorhiza maculatum* . The sight of a group of fragrant orchids, *Gymnadenia conopsea* drew our attention to a flush with fairy flax, *Linum catharticum*; tawny sedge, *Carex hostiana*; wild thyme, *Thymus polytrichus* and lesser clubmoss, *Selaginella selaginoides* and a short distance further on, a loose wet slope with yellow saxifrage, *Saxifraga azoides* and butterwort, *Pinguicula vulgaris*. Further up the ridge the plants were the more usual acid loving heather, *Calluna vulgaris*; crowberry *Empetrum nigrum*;

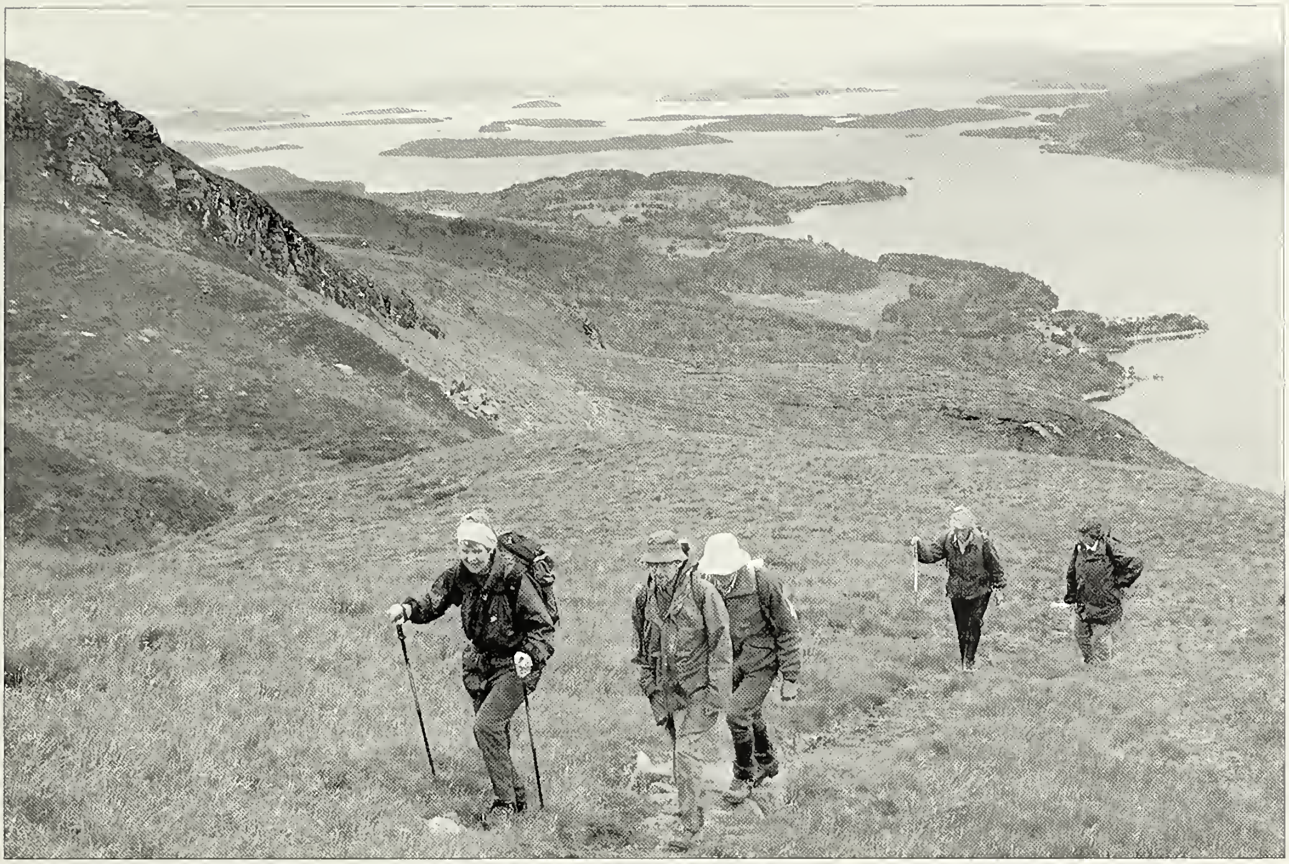

Fig. 1 A view looking south to Balloch with members in the foreground ascending Ben Lomond.

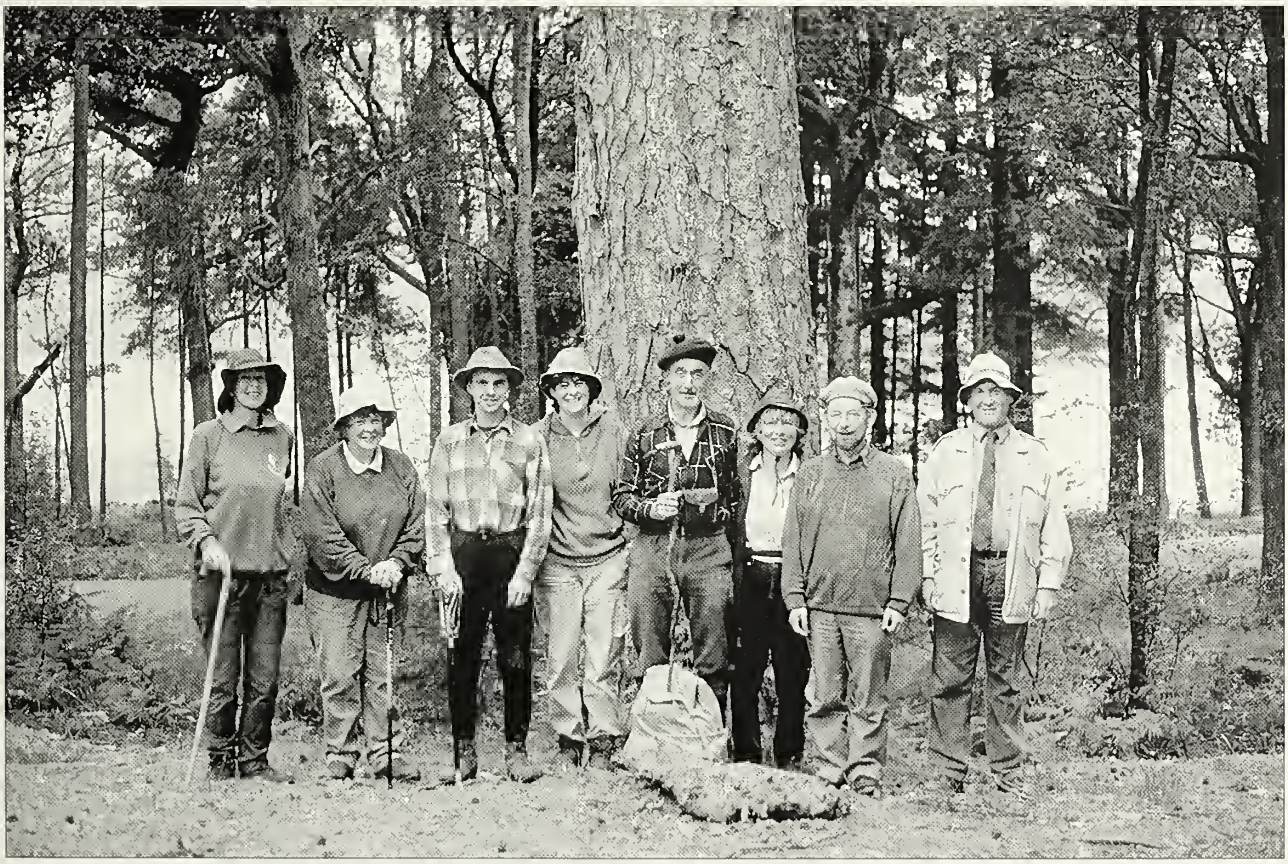

Fig. 2 Members pose for the camera. L - R Edna Stewart, Pam Murdoch, David Wyllie, Kirsty Kennedy, Bob Gray (President), Carol McLay, Richard Weddle & Robin Jones.

fir clubmoss, *Huperzia selago* and alpine clubmoss, *Diphasiastrum alpinum*.

From the summit of Ptarmigan, we descended steep grassy slopes to reach the band of cliffs on its west side. Here we were able to identify many of the plants seen in 1900. The species list is given in Table 2. One rare plant which we did not find was *Saxifraga nivalis*, alpine saxifrage. This was last recorded by John Mitchell in 1992. Several plants which we did not find in the year 2000 were seen during a BSBI meeting to the northern corries in 1995, namely *Gnaphalium supinum*, *Sibbaldia procumbens*, *Armeria maritima*, *Cochlearia officinalis*, *Luzula spicata* and *Saxifraga hypnoides*. We saw *Saussorea alpina*, alpine saw-wort, not on the 1900 list, and I have seen *Potentilla cranzii*, alpine cinquefoil,when on a BSS meeting in 1998.

In conclusion, I would suggest that the flora of Ben Lomond at present is not significantly different from that of 1900. The National Trust for Scotland have put in place a conservation plan, involving fencing off native woodland and reducing sheep numbers which can only lead to improved conditions for the plants of Ben Lomond.

Table 2 Ben Lomond plant species list for 2nd July 2000

A: Woodland

Blechnum spicant	hard fern
Ceratocapnos claviculata	climbing corydalis
Lonicera periclymenum	honeysuckle
Luzula sylvatica	great woodrush
Melampyrum pratense	common cow-wheat
Quercus robur	pedunculate oak
Ranunculus acris	meadow buttercup
Ranunculus repens	creeping buttercup
Scutellaria galericulata	scullcap
Stellaria graminea	lesser stitchwort
Veronica chamaedris	germander speedwell

B: Lower slopes – up to 300m

Alchemilla glabra	lady's-mantle
Anthoxanthum odoratum	sweet vernal-grass
Bellis perennis	daisy
Calluna vulgaris	heather, ling
Carex binervis	green-ribbed sedge
Carex pallescens	pale sedge
Carex viridula ssp oedocarpa	yellow-sedge
Deschampsia flexuosa	wavy hair-grass
Digitalis purpurea	foxglove
Euphrasia agg	eyebright
Festuca ovina	sheep's-fescue
Festuca rubra	red fescue
Galium saxatile	heath bedstraw
Hypericum humifusum	trailing St John's wort
Hypericum pulchrum	slender St John's-wort
Hypochaeris radicata	cat's-ear
Juncus bulbosus	bulbous rush
Juncus squarrosus	heath rush
Leontidon autumnalis	autumn hawkbit
Lotus corniculatus	bird's-foot-trefoil
Luzula multiflora	heath wood-rush
Nardus stricta	mat-grass
Oreopteris limbosperma	lemon-scented fern
Pedicularis sylvatica	lousewort
Polygala serpyllifolia	milkwort
Potentilla erecta	tormentil
Pteridium aquilinum	bracken
Teucrium scorodonium	woodsage
Veronica officinalis	heath speedwell

C: Bog – 150m

Carex echinata	star sedge
Carex nigra	common sedge
Carex panicea	carnation sedge
Dactylorhiza maculata	heath spotted orchid
Drosera rotundifolia	sundew
Erica tetralix	cross-leaved heath
Eriophorum angustifolium	common cottongrass
Eriophorum vaginatum	hare's-tail cottongrass
Juncus acutifloris	sharp-flowered rush
Lotus pedunculatus	greater bird's-foot-trefoil
Molinia caerulea	purple moor-grass
Narthecium ossifragum	bog asphodel
Trichophorum caespitosum	deer-grass
Viola palustris	marsh violet

D: Basic flush – 300m

Alchemilla alpina	alpine lady's-mantle
Carex hostiana	tawny sedge
Carex pilulifera	pill sedge
Carex pulicaris	flea sedge
Centaurea nigra	knapweed
Festuca vivipara	viviparous fescue
Gymnadenia conopsea	fragrant orchid
Linum catharticum	fairy flax
Pinguicula vulgaris	butterwort
Prunella vulgaris	selfheal
Saxifraga azoides	yellow saxifrage
Selaginella selaginoides	lesser clubmoss
Thymus polytrichus	wild thyme
Veronica officinalis	heath speedwell.

E: Upland heath 700m

Diphasiastrum alpinum	alpine clubmoss
Empetrum nigrum	crowberry
Erica cinerea	bell heather
Huperzia selago	fir clubmoss

F: Cliffs 650 – 700m

Anemone nemorosa	wood anemone
Asplenium viride	green spleenwort
Athyrium filix-femina	lady fern
Crepis paludosus	marsh hawk's-beard
Cystopteris fragilis	brittle bladder-fern
Cytisus scoparius	broom
Geranium sylvaticum	wood crane's-bill
Gymnocarpum dryopteris	oak fern
Hieracium agg	hawkweed
Juncus triglumis	three-flowered rush
Lysimachia nemorum	yellow pimpernel
Oxyria digyna	mountain sorrel

Persicaria vivipara	alpine bistort
Phegopteris connectilis	beech fern
Polystichum lonchitis	holly fern
Ranunculus repens	creeping buttercup
Saussorea alpina	alpine saw-wort
Saxifraga oppositifolia	purple saxifrage
Saxifraga stellaris	starry saxifrage
Sedum roseum	roseroot
Silene acaulis	moss campion
Solidago virgaurea	goldenrod
Thalictrum alpinum	alpine meadow-rue
Vaccinium vitis-idea	cowberry
Viola riviniana	common dog-violet

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GLASGOW BOTANIC GARDENS: LINKS WITH GLASGOW NATURAL HISTORY SOCIETY

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Links and co-operation between Glasgow Botanic Gardens (GBG) and the Glasgow Natural History Society (GNHS) have probably never been stronger than today. The formation of the Friends of Glasgow Botanic Gardens in 1990 has led to joint meetings and various co-operative efforts, with individuals being members of both organisations: links have been particularly strong through botanical art classes and exhibits. The frequent visits by GNHS members to GBG, especially from 1994 to 1997 led to the first extensive survey of the wildlife of the Gardens, published in *The Glasgow Naturalist* under the title of *On the Wildside*: *The Natural History of the Glasgow Botanic Gardens* (Hancock, 1998).

GBG was founded long before there was a society in Glasgow devoted to natural history, but the Garden's founder was a significant figure in the recording of the flora of Glasgow and the Clyde area. The work of Thomas Hopkirk the Younger of Dalbeth has been highlighted in the recent publication of *The Changing Flora of Glasgow* (Dickson *et al*., 2000) for his *Flora Glottiana*, the first flora of the area (Hopkirk, 1813a) - one of the first local floras published in the British Isles. An account of Hopkirk's life and work, by Richard Turner, a very active member of both the Natural History Society of Glasgow (NHSG) and the Andersonian Naturalist Society, was published in *The Transactions of NHSG* (Turner, 1886). Hopkirk had maintained an extensive plant collection, as seen in the catalogue of plants cultivated in his garden (Hopkirk, 1813b) and reissued in 1817 as *Catalogue of Plants transferred to the Glasgow Botanic Garden from the Garden at Dalbeth*. Support from the Crown established the Royal Botanic Institution of Glasgow (RBIG) which through its directors and shareholders ran the Gardens. Glasgow University, with financial acuity, made a single payment, which established that classes in botany and medicine would be provided with facilities and plant material in perpetuity - an obligation accepted by the City when the Botanic Gardens were taken over in 1891.

The appointment of (Sir) William Jackson Hooker as Regius Professor of Botany (1818-41) brought substantial early success to the Garden through his development and extensive use of the collections. It was shortly before he left to become the first official Director of the Royal Botanic Gardens, Kew, that the present Kelvinside site was purchased.

One of Hooker's students was to become an influential figure in the history of both the GBG and NHSG. The name and achievements of Dr Hugh Colquhoun M.D. have however been largely forgotten. In 1827, when Hooker had hopes of taking up an appointment at the University of London, Colquhoun was in line as a possible successor (Colquhoun, 1827). Hooker wrote that he 'had no student who (in the study of Botany) has given me more satisfaction'. Stewart Murray, the Curator, wrote 'I could not fail to observe that he showed a uniform anxiety to acquire accurate information on botanical subjects' and Principal Duncan M'Farlan said that he was distinguished by a general proficiency, with particular eminence in scientific pursuits. The breadth of his scientific interests was shown in his twice winning a prize instituted by James Watt for the best essay on physics and chemistry.

Hooker, however, was to stay in Glasgow for a further 14 years and Colquhoun pursued neither an academic nor a medical career. Instead he took over his father's business as a tea merchant. Nevertheless he continued his natural history interests and used his overseas contacts in acquiring plants for the Botanic Gardens. He joined the NHSG very shortly after its formation in 1851. He was also a director of the RBIG and rescued the Botanic Gardens from financial ruin. He took over as treasurer in 1859 and by his efforts considerably reduced its debts; by 1863 he was also secretary.

In this work he was for a time assisted by a fellow member of the NHSG, William Keddie, a lecturer in Natural Science at the Free Church College and secretary of the Philosophical Society. Keddie also wrote a guide book to the Botanic Garden (Keddie, 1861).

Numbers of business men with an interest in natural history were also jointly members of the NHSG and RBIG. Prominent among these was Alexander Bannantyne Stewart who became a life member of the former in 1864 and was an influential director of the latter. A very successful merchant in Glasgow, he became Convener of the Bute County Council - a statue on the promenade at Rothesay commemorates him. His splendid glasshouse fernery at Ascog House on Bute has recently been restored with the help of the Royal Botanic Garden, Edinburgh.

Throughout history nearly all the Regius Professors of Botany, as well as staff of the Botany Department, have been much involved with both the natural history societies and GBG. Until the RBIG ceased to exist, when the City took over the Botanic Gardens in 1891, the Regius Professor had served as a director and had great influence. More recently the joint University and Botanic Gardens 'Trades House of Glasgow Papua New Guinea Expedition', which collected plants for GBG, subsequently used in the Tropicarium at the Glasgow Garden Festival, 1988, was led by Prof. James H. Dickson and included T. Norman Tait and Keith Watson, all currently active members of GNHS.

The records of the natural history societies of Glasgow show that most of the curators and a number of the staff of the Botanic Gardens were participating members of the societies and over the years they conducted members on visits to the Botanic Gardens and exhibited specimens at meetings. These were, of course, mostly of plants, but an unusual example was a specimen of a 'banana' spider *Olios castaneus* Walck., evidently imported in a box of seeds sent by a missionary in Old Calabar, Nigeria and shown by the then curator, Peter Clark (NHSG, 1863). In more recent times Gerald Rodway, Orchid Specialist at GBG (1956-1985) was a photographic convener of the GNHS, and contributed especially on Bryophytes and Lepidoptera.

The growing links between GBG and GNHS can be a source of strength as issues of biodiversity and conservation become increasingly critical. The effective educational and scientific role of botanic gardens is helped by the active participation of members of local natural history societies and their interest in the displays and the collections.

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GLASGOW NATURALIST Vol. 23 part 6 pp 117 (2001)

THE GLASGOW NATURAL HISTORY SOCIETY AND ITS INVOLVEMENT IN POST-WAR REGIONAL PLANNING

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From the earliest days of the Glasgow Natural History Society, individual members have involved themselves in various aspects of wildlife protection. This anniversary paper draws attention to the participation of the Society as a whole in nature conservation and regional planning in the West of Scotland just over a half century ago.

The Clyde Valley Regional Planning Committee was set up during the latter days of the Second World War at the instance of Tom Johnstone, Secretary of State for Scotland. Almost certainly at the behest of Senior Technical Officer Robert Grieve (later to become Sir Robert Grieve as Chairman of the Highlands and Islands Development Board), the Committee invited the Glasgow Natural History Society - or to give them their full title, the Glasgow and Andersonian Natural History and Microscopical Society - to submit their observations on wildlife sites deemed worthy of protection which fell within the area defined by the Regional Plan (Abercrombie & Matthew, 1949).

It is unnecessary to go into the detail of the Society's response, as this appears almost in full in *The Glasgow Naturalist* (Cameron, 1946), but to offer brief comment on how each section went about its appointed task. Reading between the lines of the desk study report, the Botanical and Ornithological Sections turned for information to excursion reports in the Society's journal, whereas the Entomological Section made an analysis of the species lists in the British Association's *Handbook* for 1901 (Scott Elliot *et al,* 1901) and subsequent entries in the Clyde Card Catalogue. In the absence of historical representation within the Society, the Geological Section in their contribution highlighted several archeological sites and cultural landscapes, some of which were considered under threat. It is interesting to note that none of the appended sectional reports made a case for Arran, for it did not seem that the island was in any immediate danger of damage to known wildlife sites from post-war housing and industrial developments. Looking back with the advantage of hindsight, the prospect of introduced foreign conifers being blanket-planted over huge tracts of the island's moorland and hill ground must have seemed inconceivable.

Profitable use was to be made of the Glasgow Natural History Society's report by the newly created government wildlife agency - the Nature Conservancy - in the first wave of Sites of Special Scientific Interest (SSSIs) notified to the relevant County Planning Authorities from 1950 onwards. A few of the very best sites named in the Society's submission went on to become nature reserves administered by the Nature Conservancy, the Scottish Wildlife Trust and the Royal Society for the Protection of Birds.

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SHORT NOTES
Compiled by A. McG. STIRLING

BOTANICAL

Stowaways from Guernsey: 30 years persistence in a Glasgow garden

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In 1970 PM attended a field meeting in Guernsey organised to help record for the forthcoming flora of the island (McClintock, 1975). Another member of the party brought for identification, a specimen of western clover (*Trifolium occidentale*) with soil attached, and the leader suggested that it be taken to see if it would grow in our Glasgow garden. This plant died within three months, but six interesting plants subsequently grew from the soil: hottentot-fig (*Carpobrotus edulis*), Danish scurvygrass (*Cochlearica danica*), musk stork's-bill (*Erodium moschatum*), little-robin (*Geranium purpureum*), honeybells (*Nothoscordum borbonicum*) and four-leaved allseed (*Polycarpon tetraphyllum*) (Macpherson, 1974). Two of these plants appeared only once, one for two and one for three years, but four-leaved allseed and musk stork's-bill have persisted. The former has seeded itself into pots and troughs, and having been introduced accidentally into the conservatory, on occasions has to be weeded from nursery trays. In Guernsey it flowers from May onward, but with us appears in late summer and flowers in the early part of the winter. Plants in the garden appeared completely unscathed after the cold and deep snow of late December 2000. The stork's-bill forms large patches and has had to be removed from parts of the rockery, herbaceous and peat beds. It grows particularly well from between the path granite setts and always flowers until late November.

After 30 years, these accidental introductions are well established.

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Scirpus atrovirens in Lanarkshire (VC77)

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In September 1998, Cameron MacIver brought in a plant to Professor J.H. Dickson for identification. The specimen had been found at the site of the abandoned steel strip mill at Gartcosh, where C. MacI. was involved in ecological work with Mark Bates of Heritage Environmental. Knowing of my interest in the site, JHD showed me the specimen. Our first impression was that of round-headed club-rush (*Scirpoides holoschoenus*), a plant of dune slacks in the south of England, but the leaves were long and flat, instead of being short and inrolled (Fig. 1). We could find no match in the University of Glasgow, Hopkirk Museum Herbarium (GL). I was shown the site a few days later. Five flowering plants grew in a damp area near a pool. The tallest was almost 1.5m high. Associates were angelica (*Angelica sylvestris*), marsh thistle (*Cirsium palustre*), marsh willowherb (*Epilobium palustre*), soft rush (*Juncus effusus*), wood horsetail (*Equisetum sylvaticum*), tufted hair-grass (*Deschampsia cespitosa*) and scaly male-fern (*Dryopteris affinis* agg.).

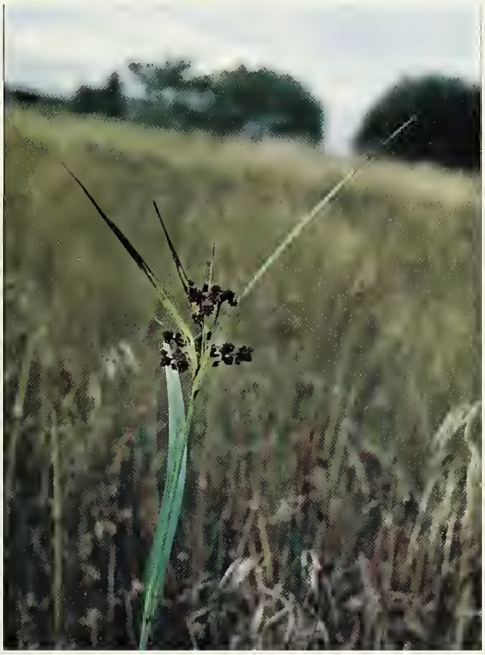

Fig. 1 *Scirpus atrovirens*

Later in the month I took the specimen to a meeting of the Botanical Society of the British Isles vice-county recorders, but failed to get the plant identified. As a result of considerable research, it has recently been identified by Dr David Simpson of the Royal Botanic Gardens Kew, as *Scirpus atrovirens* Willd., a native of northern and eastern USA and southern Canada. The little colony was still present in 2000.

Allan Stirling (personal communication) has informed me that *S. atrovirens* is included in *Gray's Manual of Botany* (Fernald, 1950), in which publication there is also a small illustration of the plant.

This is presumably the first record for the plant in the British Isles, and, therefore, the most unusual of an unusual assemblage of plants at Gartcosh (Macpherson, 2001).

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Further comments on the status of holy grass (*Hierochloe odorata*) at Blythswood, Renfrew District VC76

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In an excellent article on the current status of holy grass (*Hierochloe odorata*) by Tait (2000) there is mention of stonework on the White Cart embankment (referred to by Tait as site 2). This requires further clarification, as the significance of this stonework with regard to the conservation of holy grass at this site was clearly not known to Tait.

Following a survey of holy grass at the White Cart (Futter, 1992a) it was apparent that all areas where holy grass was found were under threat from bank erosion at high tide. The colony on the embankment (site 2) was under particular threat as much of the bank had already been washed away. A meeting was organised in July 1992 between representatives from the Mid Clyde River Valley Project, Scottish Natural Heritage and Strathclyde Regional Council to assess how to protect the holy grass on the embankment from further erosion.

It was decided that the river bank should be stabilised by using a series of gabion baskets filled with stones and mud to protect the bank and holy grass colony from further damage, and to make the stabilisation as unobtrusive as possible from the adjacent public footpath. During August 1992 the gabion baskets were put in place by staff from the Mid Clyde River Valley Project working with a team from Scottish Conservation Projects (Fig. 1). The project was funded by the Mid Clyde River Valley Project, a partnership of Strathclyde Regional Council, Scottish Natural Heritage, Renfrew District Council, Glasgow City Council and Clydebank District Council.

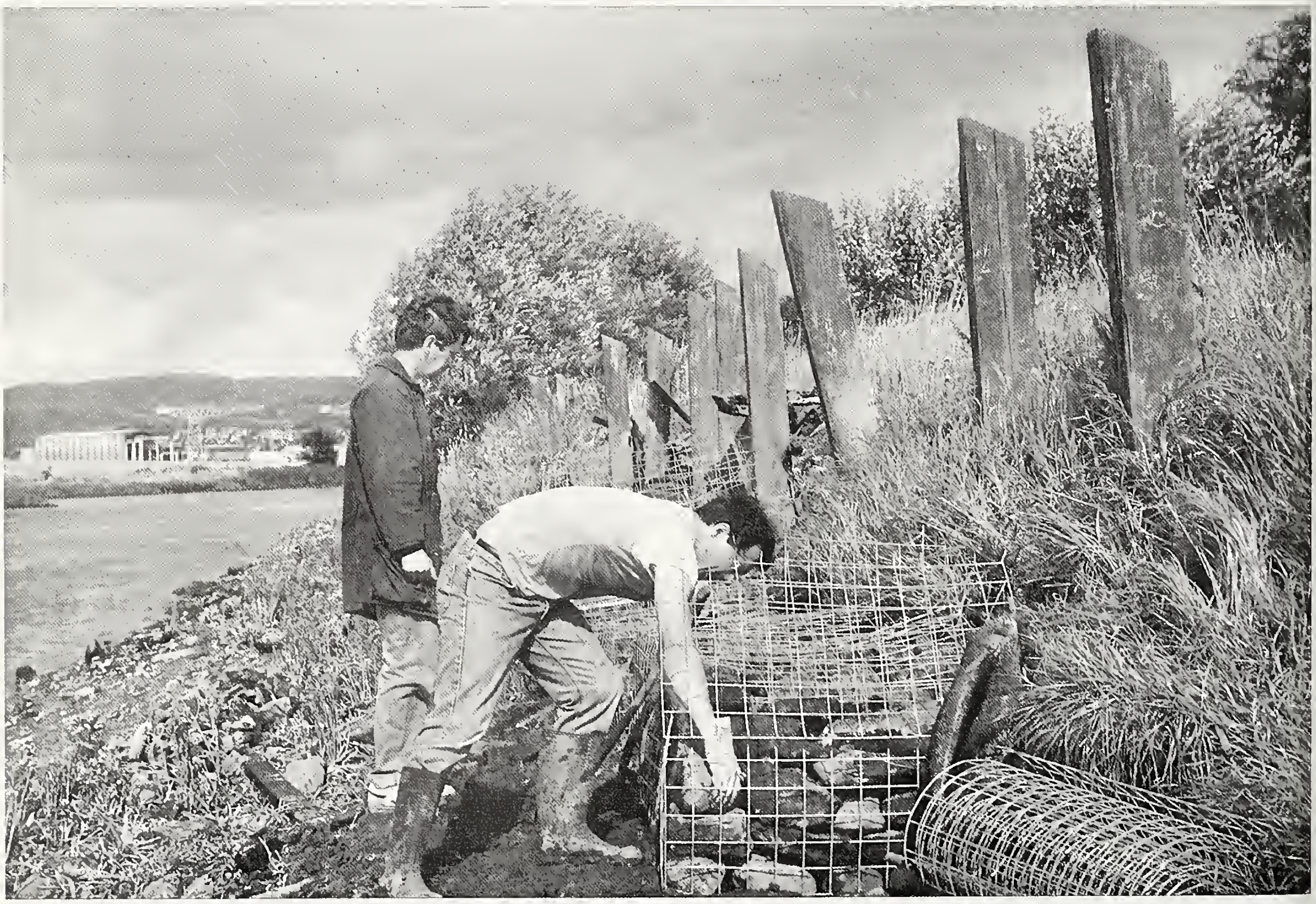

Fig. 1. Members of the Mid Clyde River Valley Project photographed filling gabion baskets at site 2 during August 1992.

Monitoring of the bank stabilisation project continued in 1993 and 1994 and the results indicated that the project had prevented the almost certain loss of holy grass at this embankment site on the White Cart (Futter, 1992b). Indeed, this site now supports the largest population of holy grass on the White Cart (Tait, 2000).

The flooding of the site by high tides in winter will continue to pose a threat to holy grass at the White Cart and only regular monitoring will ensure the survival of this Red Data book species at this site.

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ZOOLOGICAL

Orange ladybird *Halyzia 16-guttata* (L.) in Dumbarton

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While tidying our garden on 14/10/00 we found a solitary orange ladybird (*Halyzia 16-guttata*) resting in leaf litter. The orange ladybird at 6 mm in length is one of the larger ladybirds in Britain and it is easily identified by the orange upper surface with 16 large white spots and by the orange underside (Majerus & Kearns, 1989). The Cambridge Ladybird Survey (Majerus, 1995) reports a localised and scattered distribution for the orange ladybird in Scotland with no records from the Greater Glasgow area.

Our garden record (NS386752) represents one of the few known records of an orange ladybird found in the Greater Glasgow area. An examination of records held by the Kelvingrove Museum Biological Record Centre showed there were no records of the orange ladybird in Glasgow (R. Sutcliffe, pers. comm.). However, five specimens were collected by R. Crowson during 1958-1994 from woodland around Loch Lomond, including Balloch Park, and these are held in the collection of the Hunterian Museum, University of Glasgow (G. Hancock, pers. comm). The scatter of records by Crowson over the 36 year period indicates that the orange ladybird may be more widespread than at first thought and is probably under recorded in the Glasgow area.

The orange ladybird feeds on mildew rather than aphids and was thought to be a rare species until it was found to be associated with sycamore *Acer pseudoplatanus* (Majerus, 1995). The orange ladybird is now known to be relatively common in southern and central England and Wales but scarce in northern England and in Scotland. We have a mature sycamore adjacent to our garden and this may have been the source of our garden record. The other orange ladybirds recorded at the Loch Lomond area were observed on oak and birch (G. Hancock, pers. comm.).

The orange ladybird was released after examination, and photographic evidence was deposited at Kelvingrove Museum. We thank Richard Sutcliffe and Geoff Hancock for checking records of the orange ladybird in the Greater Glasgow area.

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New fish records: stoneloach, roach and a spring spawning Arctic charr population, Loch Awe, Argyll

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This note concerns three new records for Loch Awe and its catchment area.

Spring spawning Arctic charr in Loch Awe

During an experimental gill-netting survey conducted in late February 1999 at Ardchonnel, on the eastern shore of Loch Awe, ten Arctic charr (*Salvelinus alpinus*) were captured at a depth of 4-to-5 metres. On inspection of the visceral cavities, two females contained a number of mature unreleased eggs and another four of the females were found to have recently ovulated and were full of mature eggs. The four males all exhibited signs of sexual maturity with free-running milt. The eggs were removed from each female into a dry bowl and male gonads were dissected to provide milt. The fertilised eggs were incubated in flowing water and when they reached the 'eyed' stage of development they were made available to Glasgow University Field Station on Loch Lomond where the eggs continued development and the alevins hatched. This is the first recorded incidence of a spring spawning of Arctic charr in Scotland. The only previous record of spring spawning in the U.K. is from Lake Windermere (Frost, 1965).

The establishment of roach in Loch Awe

Duncan (1991) reported the capture of a single roach (*Rutilis rutilis*) during a fish community survey netting programme, from Portinnasherric, Loch Awe (GR 1973 7112) in 1987. A fish community survey of Loch Ederline (GR 1866 7025) in March 1997 by the Awe Fisheries Trust found that roach made up 86.3% of the fish community, with ages ranging from 1+ to 9+ years, indicating that a sustainable roach population may have been present within the Loch Awe catchment since 1987.

Loch Ederline is connected to Loch Awe via the 1.75 km long Ford River, entering Loch Awe at its most southerly point at Ford Village. Bull (1998) reported that during a fish community study of Loch Awe in February (16 fish), April (3 fish) and August (12 fish), 1997, roach were found to be present only in the southern basin at Ford Bay (GR 1874 7044). A total of 32 roach were caught during this survey, consisting of a single year class (2+) spawned in 1995. The mean size was reported as 117.2mm in length (± 2.5mm SE, range 97-138mm) and 23.6g weight (± 1.7g SE, range 11 - 43g). Roach were found to provide 6% of fish samples in the 1997 netting study. Further netting surveys conducted during March, 1999 found roach again in Ford Bay and also within the main water body survey sites at Finchairn Castle (GR 1899 7044) and Rubha mhic Chaisein. (GR 1885 7046). The roach samples consisted of the same year class encountered in the 1997 survey (4+), spawned in 1995. The mean size was 174.1mm in length (± 2.1mm SE, range 157-197mm) and 85.5g weight (± 3.3g SE, range 62 - 121g), plus a single specimen of older roach (9+) of 335mm length and 591g weight.

The above surveys indicate that roach are successfully established and spawning in Loch Ederline and may be spreading into Loch Awe via the Ford River. However, further evidence of multiple year classes will be required in the future to confirm that they have become well established in Loch Awe. Further surveys will also be required to investigate the movement of roach northward throughout the Loch Awe catchment and their reproductive capability.

Stoneloach in the River Orchy

Electrofishing surveys conducted by the Awe Fisheries Trust of the tributaries of the lower River Orchy during 1998, 1999 and 2000, found stoneloach (*Noemacheilus barbatulus*) at two sites. The surveys conducted in 1998 and 1999 found stoneloach in the Allt Donachain burn (GR 216200 727800), with numbers of stoneloch varying from 4 (1998) to 12 (1999) over an approximate 100 square metres of stream. A single specimen was also recorded in the Eas Eunaich burn (GR 214500 729600), a small tributary of the River Strae, in July 2000.

Despite considerable information on the fish community of the Loch Awe catchment already being available, this is the first record of this species in the catchment. The nearest record for this species on the west of Scotland is on the River Falloch (GR 2320 7170) at the north end of Loch Lomomd (Maitland and Campbell, 1992). This strongly suggests a recent invasion of the catchment by stoneloach. The mechanism (natural or anthropogenic) is unknown.

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Fieldfare flocks in winter 2000/2001

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Described by Chaucer as "the frosty feldefares" these winter birds were about the north of Glasgow and its parklands in great number this winter. Observations recorded flocks of 50 plus about Frankfield, Garthamlock and Stepps, to the NE of Glasgow by early November. Smaller batches of fieldfare flocks, around 5 to 20 birds, began to appear about open ground to the west of the city at the same time. My field notes show continuous activity from November 2000 to January 2001, the most concentrated sightings of fieldfare that I have had in twenty years of recording these birds.

The fieldfares came to the area around our house, including an old crab apple tree, and worked long and hard taking frosted, and therefore sweetened crab apples, both those remaining on the tree and the many falls. On 28 Decembeer 2000, following heavy snow, the fieldfare were early active in the crab apple, being watched at 06.50. The birds remained about the tree over the severest weather and also took cotoneaster from immediate bushes, as well as trying *Pernettia* fruits in our garden in January 2001. The birds unlike visiting redwing did not give way to aggressive display from blackbird living about the crab apple, nor did they have time for song thrush, who saw their usual food stores devoured. Surprisingly too, the fieldfare hardly moved their perches even after a local cat climbed the tree after them.

It was interesting to record fieldfare activity right into the centre of Glasgow, with flocks in trees about Blythswood Square, Sauchiehall Street and of course Kelvingrove Park. From my top floor office window in the Mitchell Library, it was possible to watch constant fieldfare and redwing activity on the morning of 29 December 2000. The nomadic nature of winter flocks, moving in relation to food supply created much of interest this winter, when the fieldfare lived up to one of their many names 'snow birds'.

Who needs wolves?

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Conservation of wolves (*Canis lupus*) and their possible reintroduction into areas where they were formerly present is a topical issue of controversy. As part of a biodiverse community they could help to maintain a healthy balance, controlling and improving the quality of prey species such as deer by selectively removing the least fit. In excess, wolves might threaten the lives of our domestic herbivores and perhaps our own safety. To cull, how much, or not to cull - that is a current question between Norway and Sweden where wolves are present (Mills, 2001).

In this country wolves were eradicated centuries ago - from England in the 15th century, in the 18th from Scotland. The freedom of England from the threat of wolves as compared with mainland Europe was evidently a subject of proud boasts in the time of Samuel Pepys. Thus the letter from London in 1662-1663 of the French Secretary of Foreign Affairs on his experiences at court in England carried a proud rebuttal (Compte de Comminges, 1663). Fresh from the elegant glory of the court of the Sun King in France's Golden Age, the Count found himself among relatively rough barbarians, aggressive drunks devoid of high culture and manners. In April 1663 he reported to his king Louis XIV that: "*Il semble que les arts et les sciences abandonnent quelque fois un pays, pour en aller honorer un autre à son tour. Presentment elles sont passés en France*" (i.e. "It seems that sometimes the arts and sciences abandon one country to honour another in its turn. Now they have passed to France"). One must forgive the flattering spin of this gallic appraisal to his Royal master, but evidently the Count was unaware of or unimpressed by such notables as Bacon, Boyle, Wren, Newton and other members of the Royal Society founded by Charles II in 1662.

However, after witnessing one violent fracas between the Duke of Buckingham and his attendants, the Count reported thus: *"Voiez, Monsieur, ce que c'est l'Angleterre! Quand je viens à faire réflexion que cette terre ne produit ni loups ni bêtes venimeuses, je ne m'en étonne pas, les hommes y sont bien plus méchants et plus dangereux, et s'il falloit se garder de tout avec précaution, le meilleur seroit de l'abandonner."*

("See, sir, what England is! When I consider that this land produces neither wolves nor venomous beasts, I'm not surprised that the men are much more aggressive and dangerous, and if one must take every precaution to guard oneself it would be better to quit the place."). In short: who needs wolves if you have Englishmen. The noble Count, essentially based in London, was obviously unaware of our native adder (*Vipera berus*) or that wolves remained in Scotland for almost another century; nor did he experience or report upon the behaviour of combative Scotsmen in those years before football violence! *Plus ça change..!*

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BLODWEN LLOYD BINNS BEQUEST: PROJECT REPORTS
Compiled by ROGER DOWNIE

INTRODUCTION

I have previously reported (Downie, 1998) on the first five years of Blodwen Lloyd Binns (BLB) Bequest funding. The trustees spread the funds between projects useful to Glasgow Natural History Society, such as improving the standard of the *Glasgow Naturalist* and updating our biological recording software; and responses to applications for fieldwork assistance at home and abroad. Although some of these have led to publications in the *Glasgow Naturalist*, most have not, in part because many of the projects supported concern overseas fieldwork, which is beyond the central remit of the journal: "the Natural History of Scotland in all its aspects".

It seems a pity to deprive *Glasgow Naturalist* readers of the opportunity to read about work supported by the BLB Bequest and we have decided to institute this new section in the journal, BLB Bequest Project Reports.

The intention is to publish short accounts of work supported by the BLB Bequest, whether at home or abroad: these short accounts are like the Abstracts of conference presentations published by many journals, where a longer version of the work can be expected to appear elsewhere.

The work reported in this initial section was all carried out in 1999 and 2000. For the record, the BLB Bequest supported 39 projects in the period June 1998 to December 2000. The largest grants given were for £2,000 and the total sum disbursed was about £19,000.

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Foraging by great skuas, Hermaness, Shetland

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During June and July 2000 I completed a study on the foraging behaviour of Great Skuas (*Catharacta skua*) at Hermaness National Nature Reserve, Shetland. Part of ongoing research into seabird ecology conducted by Glasgow University. Great Skuas are large predatory seabirds, breeding at high latitudes in the North Atlantic. World population is small c.14,000 pairs with Scotland holding 58% of the total population. Despite this it is still one of Britain's rarest nesting seabirds after Little Tern (*Sterna albifrons*), Roseate Tern (*Sterna dougalli*) and Red-necked Phalarope (*Phalaropus fulicarius*). The northern isles of Orkney and Shetland hold the greatest concentrations of Great Skuas, but an increasing population since 1900 has spread it's breeding range within Scotland as well as Arctic Norway and Russia. The cause of population increase has been attributed to both a reduction in persecution and an increase of food supply in the form of fishery discards. Over half of Shetland's Great Skua population now rely on fish discards as their main source of food during the breeding season. This might seem surprising until one considers that world wide fishery discards averaged 30,000,000 tons during the 1990's. This amount of dead or damaged fish being dumped at sea is clearly not ideal, so under the Common Fisheries Policy fishery discards are to be severely reduced.

Increasing Great Skua numbers may affect other members of Scotland's seabird population. At Hermaness NNR a 50% reduction in Kittiwake (*Rissa tridacyla*) numbers is partially attributable to Great Skua predation. It is feared that a severe reduction in fishery discarding will cause many Great Skuas to switch diet from fish eating to bird eating, perhaps having a detrimental affect on other seabirds such as Kittiwakes (*R. tridactyla*), Puffin (*Fratercula arctica*) and Storm Petrel (*Hydrobates pelagicus*). It could also affect the Great Skua population, as they readily turn to cannibalism during times of food shortage.

This project investigated whether Great Skuas feeding on discards have to travel further than those feeding on birds. I also investigated if poor visibility (fog is a common summertime occurrence in Shetland!) affected those skuas who have to locate fishing vessels out at sea, differently from those hunting along the seabird-rich cliffs close to the skua colonies. It was also important to understand foraging behaviour of Great Skuas under present conditions in view of proposed changes to the fishing industry. To investigate these possible differences I first determined the feeding specialisation's of c.50 Great Skuas. This was achieved by collecting pellets - regurgitated indigestible material - and prey remains within each territory. Pellets contain fish bones, rabbit bones and feathers from which we could infer the diet of the territory holders. Several fish and bird-eating adult Great Skuas were selected, which were attached with small radio transmitters to the tail feathers. These would then fall off when the bird moulted at the end of the breeding season. These transmitters tracked the skua's movements, building up a picture of the feeding sites and distance travelled for each bird over the summer.

Despite being dogged with technical difficulties and bad weather - Shetland experienced hurricane force winds in the last week of June! - results suggest Great Skuas specialising in eating fish discards do have to travel further than bird-eating skuas. Results also suggest poor visibility reduces the distances fish-eaters travel, but not bird-eaters. As weather conditions in Shetland are rarely stable, perhaps fish-eating Great Skuas are quite happy to miss-out on foraging for one day in the hope that the following day will bring better conditions.

This project, kindly supported by a Blodwen Lloyd Binns Award, was able to provide a new insight into the feeding behaviour of one of Britain's rarest breeding seabirds. It may also help to assess changes to the marine ecosystem around Scotland brought about by proposed changes to the fishing industry.

The ecology of incubation in Arctic-breeding waders

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This project was funded by the British Ornithologists' Union, the British Ecological Society and the Frank M. Chapman Memorial Fund, as well as the Glasgow Natural History Society. The fieldwork was successfully completed during June and July 2000. Data analysis is progressing well, and I presented talks on the study at the British Ecological Society Winter Meeting and the EGI Bird Biology Conference during January 2001. One manuscript has already been submitted for publication, a second is in the final stages of preparation and a third is planned. Summaries of these manuscripts follow.

1. The effects of steady state incubation costs on incubation scheduling in semipalmated sandpipers

Will Cresswell, S. Holt, J.M. Reid, D.P. Whitfield & R.J. Mellanby

Submitted to *Auk*, December 2000.

A key factor in the evolution of mating systems in birds is the ability of a single parent to incubate the eggs and raise the young. We investigated whether biparental semipalmated sandpipers were constrained in incubation bout length by the steady state costs of incubation. We inserted an insulated cup around nest linings so that the cooling rate of eggs was reduced by 21%. Semipalmated sandpipers responded by increasing their mean incubation bout length of 11.1 hours by approximately 7-10% compared to unmanipulated nests. Bout lengths in natural nests increased as the season progressed independently of weather but decreased for later initiated nests and with increasing rainfall. The results suggest that bout length in semipalmated sandpipers is constrained by their cumulative energetic expenditure during the bout and this is determined partly by the high costs of steady state incubation.

2. Loss and nest scrape design in pectoral sandpipers

J.M. Reid, W. Cresswell, S. Holt, R.J. Mellanby & D.P. Whitfield

To be submitted, February 2001.

For birds nesting in cold climates, maintaining clutch temperature during incubation can be a demanding and costly phase of reproduction. Adaptations that minimise rates of clutch heat loss are therefore expected. Working on pectoral sandpipers, we tested the hypotheses that the use of a lined nest scrape reduces the rate of heat loss from a clutch, and further, that scrapes are effectively designed to minimise heat loss rates.

We found that the use of both a bare nest scrape and of lining material reduced the cooling rate of a standard object. Scrape construction is therefore likely to function to insulate a clutch.

The rate of heat loss from within a scrape varied with the depth of both the scrape lining and the scrape itself. On average, pectoral sandpipers used approximately the depth of lining material that minimised heat loss whilst minimising the amount of material used. Further, mean scrape depth was approximately equal to that which minimised forced convective cooling whilst minimising the rate of conductive heat loss to cold ground. Thus pectoral sandpiper scrapes were approximately of dimensions that minimised heat loss given the conflicting thermal pressures of the environment.

Different lining materials varied significantly in insulative quality when both wet and dry. pectoral sandpipers did not use lining materials in the proportions expected from their local availability. Instead, as relative useage was correlated with a material's insulative quality when wet, we suggest that pectoral sandpipers select lining materials so as to minimise clutch cooling rate when nesting in a damp environment.

3. Clutch heat loss and the energetic demand of incubation in pectoral sandpipers

Using the doubly labelled water technique, we measured the daily energy expenditure of female pectoral sandpipers incubating on natural nests, and on nests from which we artificially reduced the rate of heat loss by inserting heating mats under the clutch. We simultaneously used an automated logging system to record the female's pattern of nest attendance. Using these data, we will quantitatively test the hypothesis that the insulative quality of the nest influences a parent's overall rate of energy expenditure, and consider the consequences of this relationship for parents' incubation behaviour.

Collecting *Begonia sutherlandii* in Kwazulu Natal, South Africa

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The purpose of my Blodwen Lloyd Binns sponsored trip to South Africa was to collect samples of *Begonia sutherlandii* for use in my PhD research project. My interest in Begonia stems from my time as an undergraduate Botany student at Glasgow University, and I am now one of three students currently investigating the evolution and development of Begonia, funded by the M.L. MacIntyre Begonia trust. One of the questions posed by the genus *Begonia* relates to the huge number of species it contains: at ca. 1400 species it is one of the top 10 angiosperm genera in terms of species numbers, so it would seem the genus has a remarkable propensity for generating new species. One possible reason for this fecundity could be the poor powers most *Begonia* species have for dispersing their pollen and seed, which would lead to different populations becoming genetically isolated from each other over relatively short distances, and eventually allowing them to differentiate into distinct taxa. I chose *B. sutherlandii* as one of the species I am using to investigate this question as it has a very interesting distribution in South Africa. It is largely restricted to relict forest patches left isolated between tracts of grassland as the area began drying out over the last few million years. As *B. sutherlandii* only grows in shaded stream banks or rock faces in such forest patches, its patchy distribution gives isolated populations between which one can look for evidence of pollen and seed flow using DNA markers. Finding out how much gene flow occurs between populations, and over what distances, will give some insight into how *Begonia* has diversified into so many species. The wilderness areas of Kwazulu Natal where I collected *B. sutherlandii* were very beautiful places, having both large areas of open grassland with striking flowers such as *Kniphofia* and *Agapanthus*, and thick forest patches in gulleys, carpeted with *Streptocarpus* and *Impatiens*. I travelled throughout the province for three weeks, covering a huge area ranging from the high Drakensberg Mountains to the hot and humid coastal forests, and collected over three hundred leaf samples. All in all, it was a very successful and enjoyable trip, and the samples I collected should lead to a better understanding of how *Begonia* has diversified.

The genetics of adaptive diversity in Scottish stickleback populations

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The revolution in molecular genetics has allowed scientists to bridge the gap between genes, nervous systems and behaviour. This is an important advance and existing model species (nematode worms, fruit flies, mice and human beings) serve the purpose well. There are other important questions about genes and behaviour (for example, what genetic processes generate adaptive behavioural variation in natural populations and what role do these play in the origin and maintenance of biodiversity?) that could also be answered with molecular tools. However, to do this we need a different kind of model species; on the one hand it must be easily reared in the laboratory but on the other, the variability of this species in the wild and the ecological consequences of this variability must be well understood. A small species of freshwater fish that is abundant in Glasgow and in Scotland generally, the three-spined stickleback, fits this description perfectly. The Blodwyn Lloyd Binns Trust has helped to fund a programme of pilot research on sticklebacks aimed at relating genetic diversity at the molecular level to variability in a complex and ecologically important behavioural trait - the response to predation risk.

Our strategy was to bring wild-caught sticklebacks (100 in all) into the laboratory and to screen their behaviour in a potentially dangerous environment (a standard way of quantifying anti-predator responses). We then set up crosses between fish at the extremes of the behavioural continuum, mating those that showed a strong fear response to those that effectively ignored the potential risk. These crosses produced over 200 offspring (the F1 generation), which were screened in turn, using the same standard behavioural test. Encouragingly, analysis of the data from the F1 generation shows a bimodal distribution of behaviour in all broods, which suggests that variability in response to danger may have an inherited basis. A few of the F1 fish have been retained to produce a second (F2) generation. DNA has been extracted from the rest and from their parents, by Dr Peggy Shelbourne and her colleagues at IBLS's Division of Molecular Genetics. The extracted DNA has been sent to Professor David Kingsley at the Howard Hughes Medical Centre, Stamford, US, who has already made good progress in characterising the stickleback genome and is sequencing the material from our fish. Professor Kingsley will visit Glasgow University in April 2001 to discuss and interpret the results. Should we be successful in breeding the F1 fish (it is not always easy to get laboratory-reared sticklebacks to breed), further behavioural screening and DNA sequencing will be carried on the F2 generation.

Overall, this collaborative pilot project has gone very well and, depending on what emerges when we relate DNA sequences to behaviour, we hope to start a larger-scale investigation of the inheritance of complex, adaptive behavioural in this new model species. The generous support (£2000) from the Lloyd Binns Trust was critical to the success of the project, paying for a research assistant to screen and rear the fish and for the (very expensive) reagents needed for the DNA extraction.

Habitat use of Kirtland's warblers *Dendroica kirtlandii* wintering in the Bahamas

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AIMS

- To determine the types of habitat used by the globally threatened Kirtland's warbler (KW) *Dendroica kirtlandii* in its wintering grounds in the Bahamas.
- To use this information to better inform conservation efforts for the species.
- Refine stable isotope analysis techniques for more specific application to these types of study, by using different tissues from birds as sampling units; and identifying how habitats reflect isotopic signatures over different time scales.

BACKGROUND

KW is one of the worlds rarest birds and is designated as globally vulnerable. Conservation efforts have focused on the breeding areas in Michigan, USA. It was considered previously that winter habitat was not of great conservation concern for the species, since the dry scrub habitat it was thought to favour was extensive, and not under threat from development (Kelper *et al.*, 1996). However recent work suggests that the species is an extreme habitat specialist in winter, relying solely on Caribbean pine woodland (Haney *et al.*,1998). This is an extremely restricted habitat, which is threatened by development throughout the archipelago. Thus, it is crucial that the issue of winter habitat use is resolved.

The rarity and elusiveness of KW in the wintering areas has hitherto precluded any accurate assessment of habitat requirements via conventional means and in order to fully resolve the issue further expensive and very time-consuming efforts would be needed. This project attempted to circumvent these problems by using the novel technique of stable isotope analyses to identify wintering habitat in the Bahamas.

The method relies on the fact that habitat specific isotope signatures are reflected in the tissues of organisms in a predictable manner. These signatures vary among habitats and recent work has used this technique to identify habitat selection in birds, mammals, fish and insects (Hobson, 1999). Since stable isotope signatures of tissues reflect those in the diet at time of synthesis (Hobson & Clark, 1992), tissues such as feathers preserve an isotopic record of the habitat in which they were grown (e.g. Hobson & Wassenaar, 1997, Bearhop *et al.*, 1999). We selected several bird species indigenous to the Bahamas with different habitat preferences as proxies for KW. The species selected occupied similar niches to KW (i.e. mostly insectivorous and arboreal). Isotope ratios in the feathers of proxies were used to create isotopic 'fingerprints' for each habitat type.

KWs undergo a partial moult in the wintering areas and feathers grown during this period will preserve the isotope signatures of the habitat in which they were grown. Small numbers of these birds are caught on the breeding grounds in Michigan each year as part of an ongoing monitoring programme. Thus, it is possible to access winter habitat information by clipping the appropriate feathers from KWs trapped on the breeding grounds and analysing their stable isotope ratios.

FIELDWORK

On 6th April 2000, SB and SCV flew out to the New Providence, Bahamas to commence an arduous four weeks of fieldwork. Teaming up with Eric Carey, of the Bahamas Department of Agriculture for two days of discussion and acclimatisation we also made arrangements to travel south to Long Island. This island lies approximately 120 km south of New Providence and saw the start of our sampling work. Four days of mist-netting in the dominant coppice habitat provided us with experience of just how difficult it was going to be to sample birds in the hot conditions. Returning briefly to New Providence we then quickly travelled on to Andros, the largest and most under-developed island in the archipelago. At Staniard Creek we stayed in accommodation provided by Dr Luther Brown, who also kindly provided us with the use of a fantastic pink Landrover. The next two weeks were spent exhaustively trapping in a mixture of coppice, mangrove and Caribbean pine forest. The heat, persistent biting insects and poisonous plants saw to it that life was not going to be easy. A number of health scares because of poisonwood *Metopium toxiferum* seemed destined to ruin out plans. (Poisonwood is a poisonous plant common in the Bahamas, the sap of which cases severe burns and because the sap is insoluble in water it is very difficult to remove or treat). However following treatment we were able to carry-on with the work and managed to obtain samples of the target bird species in all three of the different habitats. At the end of an incredibly demanding two weeks we returned to New Providence, on route to Abaco.

A disastrous mix-up with Bahamas Airlines meant we were stuck on New Providence, however a chance meeting with local lawyer and conservationist Pericles Maillis resulted in a relaxed evening at his family home on the south side of the island. The following day we managed to charter a small plane northwards to the island of Abaco to team up with Glasgow University ex-pat, Colin MacLeod. Travelling to the south end of the island we stayed in the Hole-in-the-wall lighthouse, within the boundaries of the Abaco National Park. For the final ten days of our time in the Bahamas we concentrated our mist-netting efforts in the extensive coppice and Caribbean pine forests of the national park. A number of species of *Dendroica* warbler (the same genus as KW) are found almost exclusively in the pine on Abaco and these were our main target species. The remainder of our research was to be conducted out with the Bahamas.

PRELIMINARY ANALYSES & CONCLUSIONS

Feather, vegetation and insect samples collected in the Bahamas were analysed at the Scottish Universities Environmental Research Centre for stable isotopes of carbon and nitrogen. The results indicated that there were consistent differences among the three habitat types and that we could discriminate between them with some confidence. Unfortunately the KW Recovery Team could only provide us with nape feathers (grown in the wintering areas) from three individuals. However, the results of the analysis of KW feathers strongly suggest that this species is reliant on Caribbean pine forests during the wintering period. We firmly believe that with a continuation of this research we may be able to resolve the problems we have encountered and we fully intend to conduct follow-up work in 2001/2002.

While these findings can only be considered preliminary, they provide compelling evidence that Caribbean pine forests, which have recently come under renewed pressure from logging activity, are an important wintering home for one of the worlds most endangered bird species.

ACKNOWLEDGEMENTS

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Glasgow University Trinidad Expedition, 2000

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INTRODUCTION

The year 2000 expedition was the 8th to Trinidad in the period 1989-2000, and comprised 23 staff, undergraduates and postgraduates of the University of Glasgow. All members of the expedition contributed to the fund-raising effort which made the expedition possible. Grants from the Carnegie Trust, the University of Glasgow, the Gilchrist Trust, the Albert Reckitt Trust and the Blodwen Lloyd Binns Bequest were all essential to the success of the expedition.

The aims of our expeditions to Trinidad are a mix of fundamental investigations into aspects of tropical biology, and work that is some aspect of conservation biology. A subsidiary aim is to give students the opportunity to experience tropical ecosystems and to interact with a different culture. Contacts with the local people are always an important aspect of our expeditions. We were particularly pleased this year with our interactions with locally-based non-governmental organisations and a children's summer camp, both in association with our turtle conservation project.

It would be impossible in a short report of this kind to go into the details of all the work carried out on this multi-project expedition. Instead, I will list the main project areas and give some details on one of them. A copy of the full expedition report is available from the author on request. Copies are also deposited in the University of Glasgow's Main Library and the Graham Kerr Building library.

The main project areas were:

- **Turtle conservation** Monitoring of marine turtle nesting on Trinidad's remote north coast.
- **Forest bird ecology** Monitoring of forest bird numbers, with additional investigations into the behaviour of particular species.
- **Land crab behaviour** Investigation of signalling behaviour and escape responses of two species of mud flat crabs.
- **Treefrog adhesion** Investigation of the adhesiveness of different treefrog species on a variety of surfaces, and study of how adhesiveness and sticking behaviour changes as frogs grow.

Amphibian Reproductive Ecology

1. Introduction

University of Glasgow expeditions have carried out studies on Trinidad's amphibians since 1989. Trinidad has a diverse amphibian fauna (around 30 species of frogs and toads - Murphy, 1997) which is related to its tropical location, close proximity to the South American mainland, and the wide range of suitable habitats found within a relatively small area. These habitats range from forest-clad mountains with fast-flowing streams, to undulating plains with mixed forests and grasslands, to freshwater swamps. Some of our work has focussed on rare and therefore threatened species, such as the golden tree frog (Clarke *et al.*, 1995), and on the value of amphibian species as indicators of environmental health. However, our main emphasis has been on seeking a better understanding of the basic biology of Trinidad's frogs, especially their life histories. This work has generated a considerable list of publications in refereed journals as well as expedition reports.

Although our expeditions coincide with Trinidad's main rainy season, our experience is that the onset, duration, and distribution of the rains can be very patchy. This makes it very difficult to be certain which amphibian work will be feasible in a particular year. In 2000, we were fortunate with the rains, which at the start of the expedition fell just at the right times, allowing good progress to be made on several projects.

2. Metamorphosis: duration and body compartment changes

The physiological control of metamorphosis through thyroid hormone is well established: and there is a voluminous literature on the ecological factors that determine the onset of metamorphosis. However, the duration of metamorphosis itself has been somewhat neglected, as have the changes in general body compartments that accompany it. This is somewhat surprising, since metamorphosis is a complex suite of changes, affecting every organ system - but is also a life history stage when the frog is relatively helpless, but is preparing for terrestrial life. We might expect frogs to go through metamorphosis as quickly as possible to minimise their period of helplessness, and with maximal efficiency, so that resources accumulated in the body before metamorphosis, in the tail and fat body for example, are available to the froglet as it begins its new life in terrestrial conditions.

- To investigate these changes, we collected spawn and tadpoles of 10 species, from three families (see Table 1), reared them in the laboratory, then, when the forelimbs emerged (start of metamorphic climax) measured the parameters listed in Table 2. A sample of specimens was fixed at metamorphic onset and completion (tail completely disappeared), then dissected into tail, fat body, gut, carcass. Each of these compartments was weighed wet and dry to assess relative changes during metamorphosis. The project has generated a large amount of data, still being analysed. In addition to these quantitative data, we recorded the behaviour of different species during metamorphosis, to assess whether there are any relationships between behaviour and factors such as metamorphic duration.

Table 1: Species examined

Leptodactylus fuscus *L. validus* *L. bolivianus* *Physalaemus pustulosus*	(Fam.Leptodactylidee)
Colostethus *(=Mannophryne) trinitatis*	(Fam.Dendrobatidae)
Hyla geographica *H. crepitans* *H. punctata* *Phyllomedusa trinitatis* *Phrynohyas venulosa*	(Fam. Hylidae)

Table 2: Metamorphic parameters measured

- metamorphic duration (to 0.3day)
- wet weight at start and finish
- body and tail length at start and finish
- compartment weights (wet and dry) at start and finish (for carcase, gut, tail, fat body)

3. Timing changes in early amphibian larvae

There is considerable interest in the relationship between developmental and evolutionary events. An important concept is heterochrony, the idea that many evolutionary changes occur as a result of alterations in developmental timing. Timing changes may occur in early development because of modifications in life history parameters such as egg size and stage at hatching. We are investigating such changes by cataloguing the development of larva-specific structures in a range of Trinidad (and other) amphibians which employ a variety of reproductive modes. The structures we are concentrating on are:

- hatching glands
- adhesive glands
- ciliation patterns
- external gills
- lateral line organs

During the expedition, eggs of 10 species were collected as soon after deposition as possible, incubated in the laboratory, then fixed at representative stages for both light and electron microscopy. Analysis of these specimens is currently proceeding.

4. Predator - prey interactions in the stream frog *Colostethus* (=*Mannophryne*) *trinitatis*

Our previous work (Downie *et al.*, in press) has shown that male *C. trinitatis* choose pools to deposit their tadpoles into, so as to avoid aquatic predators (fish and shrimps). However, fish and shrimps may be able to colonise new pools. It would therefore be an advantage for *Colostethus* tadpoles to have some kind of anti-predator defences. In addition, some streams appear to be so full of predatory fish that it must be very hard for the males to find suitable pools: what do they do then?

We investigated several aspects of this interaction. By setting out artificial pools some distance from the main streams, we were able to show that frogs will deposit tadpoles in bodies of water away from the stream, and free of predators. We also tested whether there is a cost in delayed growth if tadpoles are not deposited immediately, but are kept on the male's back for some days: the results suggested that there is an optimum time for being on the male's back, somewhere between the shortest and longest possible. Finally, we asked whether tadpoles have any defences against predatory fish: we found that tadpoles detect fish, mainly by chemo-sensory means, and that they stay as far as they can away from the fish.

5. Aerial respiration in tadpoles: developmental timing and the effect of environment

In some species of frogs, tadpoles develop lungs at an early stage, and are capable of aerial respiration by swimming to the surface and gulping air. Aerial respiration in aquatic lower vertebrates has been mainly studied in fish, and relates to seasonal hypoxia. A major constraint on this behaviour is believed to be the increased chances of predation, especially by birds. Relatively little work has been carried out on aerial respiration in tadpoles (Wong, 1994). Under what circumstances does it occur? Why do some species develop lungs early and others do not? What advantages does it give, if any, to species in mixed tadpole assemblages?

We tackled some of these questions by measuring the air-breathing behaviour of 8 species of tadpoles at different developmental stages and at different levels of oxygen content in the water. The results were complex, revealing a great deal of variability in behaviour that deserves more detailed study.

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Looking good, feeling great: is there an effect on behaviour or pigmentation in lesser black-backed gulls (*Larus fuscus*) supplementally fed with carotenoids?

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The aim of this project was to investigate experimentally whether the level of carotenoids in the diet of male lesser black-backed gulls (*Larus fuscus*) influenced their pigmentation and behaviour during the breeding season.

Male lesser black-backed gulls *Larus fuscus*, like many animals, have condition-dependant visual signals. Red and yellow pigments that are usually based on carotenoids (Olson and Owens, 1998) cause the conspicuous coloration of plumage and integument in many animals. Carotenoids have been hypothesised to advertise immune function / antioxidant status (Moller *et al*, 2000; Siano *et al*, 2000; von Schantz *et al.*, 1999; Olsen and Owens, 1998; Burton, 1988;). Animals can't make their own carotenoids and must gain them from the environment, when limited they are hypothesised to impose a trade-off between visual signals and health. The individuals that have access to diet rich in carotenoids may be both brighter in colour and in better condition; these animals may then reallocate their time to maximise their needs.

In this project I have hypothesised that supplementally feeding male lesser black-backed gulls carotenoids will brighten their visual signals, and either 1) improve their condition allowing them to reallocate their time effectively, 2) alter their sexual behaviour as affected by attractiveness. I measured colour and behaviour of carotenoid fed compared to control birds during the period of time when first clutch had been removed and the next clutch had not yet been laid (recycling period). The measurement of behaviour was carried out by filming the territories of the pair of gulls and measuring the time spent on certain behaviours. Those behaviours were activity, preening, courtship feeding, copulation and territorial aggression. The Lesser black-backed gull is slate mantled, has a scarlet eye ring and yellow bill and legs. The male of the species can be distinguished from the female by its size. The areas we are measuring in this project are bill, billspot, gape flange, orbital ring and tarsus . The colour of these birds was measured after they were caught in a walk-in trap and it was measured using a colour chart. I also accounted for environmental conditions that may effect behaviour such as weather, recycling, distance from road and tide.

The study site was South Walney Nature Reserve, Cumbria Trust For Nature Conservation.

The Island of Walney lies just off Cumbria's Furness peninsula. At ten miles long and three quarters of a mile wide it is the largest of the seven islands in the area.

The eastern coast of the island is a continuous mudflat. Small bays and channels have formed by erosion due to the ebb and flow of the tide. The Western side faces the Irish Sea and the westerly winds cause serious erosion due to the sea action.

The Island is relatively flat with sand dunes at the North and South ends and red boulder clay covered with sand and turf in the middle part of the island. The island has a large breeding colony of 24,000 pairs of lesser black-backed gulls and a similar number of herring gulls.

The nests that were fed were in the middle of the colony and randomly allocated to a feeding treatment. The gulls were supplementally fed in clusters of up to eight pairs, between which were buffer zones ca. 5m where no nests were fed or allocated.

One hundred nests were fed with 2mg total carotenoids in 20g fat and the one hundred other nests were fed with 20g fat (control group).

My results show no significant increase in pigmentation (see Fig. 1), there was however a difference between the two feeding treatments. They show male carotenoid fed gulls have increased territorial success (see Fig. 2), spend more time on territory and have an increased courtship-feeding rate. It is known that carotenoids influence the production of steroids, in that they support the steroid synthesis (Bendich, 1993). This support may increase, or at least uphold the amount of testosterone in the male's body, which is a major contributor to aggressive behaviour. In cold and wet weather all males spend more time on territory, spend more time walking when on territory, have a higher rate of courtship-feeding, spend longer in copulation attempts, and females spend more time preening. During this weather, thermoregulation becomes more expensive (Hilton *et al*, 1996), flying at these times would use up even more energy, this wouldn't be a good idea if you were reserving energy for parental care. The increased preening rate might be because preening waterproof the feathers and insulates the body (Tinbergen, 1970). There was also found to be a feeding treatment by weather index interaction increasing female territorial presence.

Various other factors affected the behaviours in gulls. Whether or not the gull pair recycled affected three aspects of behaviour. The gulls that did recycle showed less time spent on territorial aggression and at a lower rate, but showed the female spent more time walking than if it had not recycled. There were too few gulls which did not recycle (data set is too small) for these results to be of much importance. It is however important to note that this recycling was significantly different between treatment groups . All the carotenoid fed gulls recycled whereas only 55% of the control group did. This difference may be due to carotenoids protecting the reproduction tissues and supporting steroid synthesis . It reduced territorial behaviour perhaps because their time was allocated to feeding and building up reserves for the energetically expensive activity of laying a new clutch (Bolton *et al*, 1992). Of course, most of the birds that recycled were carotenoid fed birds and as we have seen early have a higher success in territorial disputes, but have a lower rate. With a larger sample size, this may be looked at in more detail. In conclusion, we can say males do reallocate their time in certain behaviours due to an increase of carotenoids, but they also reallocate due to environmental conditions.

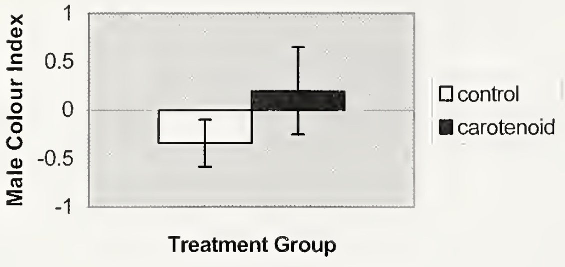

Fig. 1. This graph represents the difference between the two feeding treatments. We have used the standard error and the mean values of each group. Carotenoid males have a mean colour index of 0.1961, a standard error of 0.4511 and only 7 values. Control males have a mean colour index of 0.3431 and a standard error of 0.2439, with only 4 values.

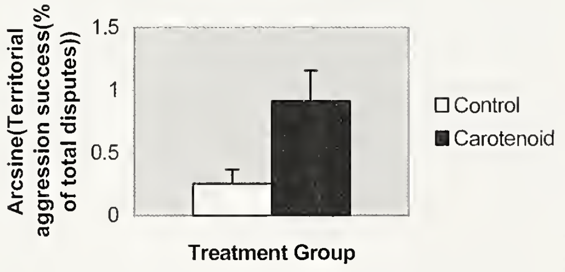

Fig. 2. This graph represents the difference between the two feeding treatments. We have used the standard error and mean values of each group. For the ANCOVA the data were transformed using arc sine for a normal distribution. The carotenoid group has a mean of 0.9129, a standard error of 0.243 with 6 values. The control group has a mean of 0.2559, a standard error of 0.1118 with 5 values. There is a significant difference between the two groups.

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BOOK REVIEWS

Compiled by RUTH DOBSON

Britain from Space

Times Books, Harper Collins, London, 2000, 128 pp., hardback with numerous colour photographs and maps. ISBN 0 00 710584 3, £16.99.

This book is largely a collection of over 60 photographs of the surface of the British Isles taken from the U.S. satellite "Landsat 5" as it circulated the Earth at an altitude of 438 miles and at a speed of 16,778 m.p.h. The photographs, as originally taken, were subject to various distortions and colour aberrations, but these have been skilfully joined together to produce the seamless pictures presented here.

All parts of the territories are covered but not at the same scale e.g. the Scilly Isles feature only in a view of the British Isles as a whole whereas urbanised areas such as Glasgow are given relatively close-up treatment. In the latter, features such as individual streets and the Clyde bridges can clearly be identified. Elsewhere, built-up areas, rivers, lakes, mountains, moorlands and areas of afforestation and cultivation are clearly distinguishable.

Each main photograph is accompanied by a map of the area depicted and a brief commentary on features of interest. An index of place names completes the book.

Ronald M. Dobson

The Conservation Handbook: research, management and policy

WILLIAM J. SUTHERLAND

Blackwell Science, Oxford, 2000, 278 pp., softback with black and white photographs, tables and diagrams. ISBN 0 632 05344 5, £24.95.

There are fourteen sections in this book: Introduction, Assessing biodiversity, Setting conservation priorities, Monitoring, Ecological research techniques, Diagnosis and prediction, Conservation planning, organisational management and fund raising, Education and ecotourism, Bringing about political and policy changes, Species management, Habitat management, Exploitation and Integrating development and conservation. So the coverage of the topic is wide with, indeed, global scale.

There are seventeen case studies and not one of them botanical and so that is hardly balanced but then the author is not a botanist. We learn about the White-tailed Eagle, the Lord Howe Woodhen, the Corncrake, the Brush-tailed Phascogale and the Amur Tiger and so on. Evidently Orchids, tropical and otherwise, are not of enough interest. Nor are the rich endemic floras of oceanic islands such as Hawaii and St Helena.

Having collected plants for several decades from most of the world's continents and many remote islands, I read the short section on plant collecting. I have never pressed Liverworts; there really is no need to do so other than thalloid ones and most bryologists do not bother; nor Lichens either. We all put collected vascular plants into poly bags which, however, are far from ideal. There is nothing better than a large vasculum. The specimens do not get crushed and stay unwilted longer. As Dr Who will tell you, a vasculum is like a Tardis, larger inside than outside. It is amazing what you can get into a vasculum and still have good specimens at the end of the day.

Jim Dickson

Microbial Diversity in Priest Pot, a productive pond in the English Lake District

B.J. FINLAY AND S.C. MABERLY

Freshwater Biological Association, Ambleside, 2000, 73 pp., softback with line drawings and photographs. ISBN 0 900386 64 9, £20.

This is a remarkable report dealing with the microbial population of a small water body. The geological history and physical characteristics are described in detail and the population and diversity of the 'microbes' described. There is an interim list of organisms which places these in context. There are 846 taxa listed of which 5 are fish and 26 are macrophytes (emergent plants). Apart from a handful of macro-invertebrates the balance is made up of viruses or virus-like particles, bacteria, fungi and protists such as amoebae, diatoms, ciliates, etc. It is only through the long-standing existence of a permanent research station in the Lake District that a study of this nature and complexity can be undertaken. If any other organisation had the capacity to analyse a pond at this level these results would be the basis for comparison. In the meantime one can only admire the achievement and wonder if anything remotely comparable will be produced.

E.G. Hancock

Lichens

OLIVER GILBERT

Harper Collins, London, 2000, 288 pp., softback with 16 colour plates, and over 120 black and white photographs and line drawings. ISBN 0 00 220082 1, £19.99.

It cannot be denied that lichens are a 'difficult' group for the amateur naturalist. The identification of many common macrolichens (leafy or bushy species) requires a hand lens and/or chemical test, and many common encrusting forms cannot be identified with certainty without examining squash preparations of their fruiting bodies in a compound light microscope. However, with persistence and determination it is possible for keen non-professionals to reach a level of competence that enables them to generate useful data.

Books are obviously of critical importance in converting curiosity to obsession and nowadays the novice is lucky to have F. Dobson's 'Lichens - An Illustrated Guide' (Richmond Publishing Company; latest edition 1999) to get them started and prepare them for the glories of the fully comprehensive 'The Lichen Flora of Great Britain and Ireland' edited by O.W. Purvis *et al.* (Natural History Museum Publications; 1992). This new book by Oliver Gilbert can also be recommended to the amateur and in some ways complements the complete 'Flora', although it is an odd mixture.

The first four chapters appear to be written for readers with little or no background knowledge of lichens: chapter 1 deals briefly with historical aspects of lichenology and lichens in the British Isles before describing their economic uses and applications; chapter 2 summarises their structure and physiology, and includes short introductions to communities and lichen collecting; chapter 3 covers interactions between animals and lichens; and chapter 4 provides quite a detailed survey of lichens as victims and indicators of air pollution. This is all good introductory stuff.

However, each of the remaining nine chapters of the book is devoted to one type of lichen habitat - trees, acid rock, heaths and moors, chalk and limestone, manmade rural environments, urban environments, mountains, lakes and rivers, and coasts. So, most of the book comprises a detailed, habitat-centred overview of lichen ecology in the British Isles, much of it based on the author's own research. Because such an overview is not available elsewhere, it is a valuable addition to the literature, but it is likely to appeal much more to already committed amateurs than to those dipping tentative toes into the water (i.e. the readership at which the first chapters are targeted). These chapters are, for example, sprinkled liberally (and unavoidably, very few lichens having common English names) with Latin binomials, frequently in sequences of 10-16, despite the author's claim in the foreword that he had avoided 'giving long lists of Latin names'. Perhaps in an attempt to make these chapters more palatable, the author sometimes takes an anecdotal approach which reaches its apogee in chapter 11 'Discovering the montane lichen flora'. Much of this chapter is a personal memoir of pioneering work by the author and his friends, and it includes evocative sketches of the trials and tribulations of the dedicated lichenologist, such as this reference to the summit of Ben Lawers:

'Under normal conditions with anorak hood up, gloves on, glasses and hand lens steamed up, wet packets disintegrating in one's bag, and the wind whipping specimens out of collecting tins before the lid can be replaced, it can appear disappointing.'

There is too much of this kind of thing for my taste, however, and I felt that the editor's red pen should have saved us from a paragraph devoted entirely to the means by which our intrepid plant hunters achieve oral gratification in the field, of which the following is a sample:

'Brian Coppins likes to stop every so often for a drink of tea from his thermos, have a bite of cake and to enjoy a quiet pipe... I am more obsessive; if the weather is fine I rarely stop, eating Mars Bars to maintain energy.'

Remarks like these, together with some equally dispensable photographs, create an aura of eccentricity that might turn some readers off.

I must stress that this is a minor irritant and that I personally found these more specialised chapters to be refreshing, inspiring and rejuvenating (only, I regret, as far as my interest in lichen ecology is concerned!). Like the rest of the book they are richly illustrated and they contain a wealth of interesting information that bears testimony to the immense contribution made by the author himself to what remains a relatively neglected aspect of British natural history.

Despite the disjunction between the two parts of the book I can still recommend it to both beginners and more knowledgeable readers. The initial chapters will encourage the former to explore the subject further and acquire the background knowledge needed to appreciate the later chapters.

Iain Wilkie

The Changing Flora of Glasgow: urban and rural plants through the centuries

J.H. DICKSON, P.MACPHERSON AND K. WATSON WITH CONTRIBUTIONS FROM D. HAMMERTON, W.G. JARDINE AND M.C. JARVIS AND PHOTOGRAPHY BY T.N. TAIT

Edinburgh University Press, Edinburgh 2000, 402 pp., hardback with 23 colour plates, numerous species maps, maps, drawings and black and white photographs. ISBN 0 7486 1397 8, £30 (£20 to members of GNHS).

Subtitled *Urban and Rural Plants through the Centuries*. - this thoroughly researched account of the flora in and around Glasgow, past and present, is a fitting accompaniment for the 150th anniversary of the Glasgow Natural History Society.

In recent years we have come to expect the regular publication of floras of specific areas, usually vice-counties or rural areas of particular biological interest, but such accounts specifically dealing with urban areas and their environs are quite rare. None treat the subject with such thoroughness as the present work. It is the product of many years of effort by the compilers, researching the literature and local herbaria as well as collating the results of field work by past and present recorders. Much is owed to earlier botanists who, although their published floras deal with the wider Clyde region, nevertheless contributed greatly to our knowledge of the city's plant life. The records of Hopkirk, Hooker, Hennedy and Lee are prominent throughout the book.

As the title indicates, considerable emphasis is placed on the 'changing' nature of Glasgow's flora, and the background sections develop this theme in a particularly interesting fashion. A possibly unique feature is the inclusion of old maps and photographs to illustrate the way in which the topography of the city has changed over the centuries. The various factors which have affected the composition and character of the city's plant communities are noted, for example - changes in methods of refuse disposal, and the decline in imports of grain, both formerly rich sources of alien plants. Now, more recent changes have brought a different mix of foreign species and Glasgow's river-side flora now includes, among others, giant hogweed, Himalyan balsam and Japanese knotweed.

The greater part of the book is taken up by the catalogue of past and present species recorded within the study area, a rectangle 20km by 18km, within which the recording unit is the tetrad (2km x 2km). For each species the entry covers the common and scientific name, status in the area (British, introduced etc), relative abundance in the rectangle, first evidence, and finally local distribution. In some, but not all, cases distribution of species in the 90 tetrads is indicated by dot maps (produced by D-map), and these have shading to show the more heavily built-up districts. Where appropriate there are notes on habitat and locations. There are many examples of the unexpected - adder's-tongue fern at Braehead, Renfrew, a site now occupied by a large retail complex, stag's-horn clubmoss in the grounds of the Necropolis by Glasgow Cathedral, and royal fern on the canal bank near the city centre.

The cost of this volume is fairly high for a botanical work of local interest, even at today's prices, but it reflects a quality production. The printing and illustrations are of a high standard and the colour photographs have the excellence we have come to expect from Norman Tait. However, the subject chosen to represent *Dactylorhiza purpurella* appears not to be that species but probably a hybrid with one of the spotted orchids.

Conservation and pollution are only two of the many fascinating aspects of the city in relation to its flora explored in this book - more than can be adequately dealt with in this review. I can confidently recommend it to readers with a botanical interest and also a general interest in the city.

Allan McG. Stirling

Sea Beans and Nickar Nuts

E. CHARLES NELSON

Botanical Society of the British Isles, London, BSBI Handbook No 10, 2000, 156 pp. softback with maps and numerous drawings. ISBN 0 901158 29 1, £13.95.

The title refers to drift-seeds of various kinds - seeds or fruits which have floated across the ocean to arrive eventually at a beach. This book answers several questions e.g. why do they float? - will they germinate after months in salt water? - how can we decide if a seed stranded on a beach is a true drift-seed? It contains a useful map showing the surface currents in the North Atlantic Ocean (including the information that the Gulf Stream does not come near Europe - it turns south near the Azores - it is the North Atlantic Drift which helps to maintain the relatively mild climate of our shores). There is also a map of the British Isles, which shows the currents in relation to our coasts, and indicates the beaches where drift-seeds have been collected during the last 300 years. There is an interesting chapter on the history of drift-seeds, including Charles Darwin's interest in them, and also associated folklore from Iceland, Norway and the Hebrides.

The remaining two-thirds of the book gives an illustrated key and detailed descriptions of 55 drift-seeds. These include records of findings in Europe, viability when tested for germination and descriptions of the mature plants which could develop - many could be large tropical specimens, impossible to grow as house-plants!

Edna Stewart

The Flora of Tiree, Gunna and Coll

D.A. PEARMAN AND C.D. PRESTON

Published privately by the authors, 2000, 168 pp., softback with distribution maps and tables. ISBN 09538111 1 5, £9.00. Obtainable from Mrs A.V. Pearson, The Old Rectory, Frome St. Quentin, Dorchester, Dorset DT2 0HF.

The islands of Tiree and Coll and the small uninhabited island of Gunna are, I believe, the most beautiful islands in Scotland. The north-west beaches of Coll are arguably the most beautiful in the world. Despite their similar geographical location, each island has unique habitats that encourage an incredible diversity of plants. It has been a real privilege for me to have been the Botanical Recorder for these wonderful islands. Because of my intimate knowledge of these islands, I am in a very good position to judge the quality of this flora.

This book has been written by two people with immense botanical knowledge with whom I have had the pleasure of botanising on many occasions. This book draws on the extensive fieldwork which has taken place since 1941 (Heslop Harrison *et al.*). It includes recent work completed by recorders (in particular Mrs Joan Clark), and work by botanists completed mainly during several BSBI field meetings. The considerable work involved in producing this flora has culminated in a wonderful and informative book that introduces readers to a small, yet beautiful part of Scotland.

This flora is full of information about the distribution of the higher plants found on the islands. It gives information for botanists as well as general visitors to the islands, who wish to learn more about the species that are present. It allows visitors to identify some of the common plants they find and it gives excellent and often detailed habitat information.

I would like to highly recommend this book to members and others, as being very well researched and yet very accessible. *A Flora of Tiree, Gunna and Coll* is a must to take with you when visiting these beautiful islands.

Agnes Walker

Editor's note

Publication of this flora received assistance from the Blodwen Lloyd Binns Bequest.

Vegetation Communities of British Rivers: a revised classification

NIGEL HOLMES, PHILIP BOON AND TERRY ROWELL

Joint Nature Conservation Committee, Peterborough, 1999, 114 pp., softback with numerous maps and tables, 5 pages of colour photographs. ISBN 1 86107 458 1, £35.

This review updates earlier survey work carried out some 20 years ago. A system of classification of rivers, throughout Britain, is presented based on presence and abundance of aquatic plants. Samples were taken along 1 km stretches of river, noting geology, substrate, flow, inundation etc. In total 1514 sites have been analysed and classified into 4 groups, with 10 types and 38 sub-types; the spread ranging from nutrient rich/calcareous ones to more acidic types.

The first part provides detailed descriptions of the types with the typical species, and a lengthy annex shows distribution maps plus tabulated data. Finally there are descriptions of survey methodology and a key to aid identification of a sample to the relevant type. The book concisely presents a great amount of information, gathered from the extensive surveys, tried and tested over a number of years. It is not a gentle read about rivers and associated features. Unfortunately there appear to be no samples taken from the Clyde valley catchment. However anyone wishing to study or sample local water courses will find this book a very useful and standard reference source.

Keith Watson

A key to the freshwater triclads of Britain and Ireland with notes on their ecology

T.B. REYNOLDSON AND J.O. YOUNG

Freshwater Biological Association, Scientific Publication No 58, Ambleside, 2000, 72 pp., softback with line drawings and a colour plate. ISBN 0 900386 63 X, ISSN 0367 1887, £14.

Earlier FBA publications (1967 and 1978) on the free-living flatworms that live in lakes, ponds, streams and rivers have now been supplanted by this new booklet. The identification keys deal with both live and preserved specimens which latter is particularly useful when utilising bulk invertebrate sampling methods. There are twelve species known from the British Isles currently. One of these, *Phagocata woodworthi* Hyman, is a native of North America but found in Loch Ness. It is conjectured that it was introduced on equipment brought over by American so-called scientists searching for the monster. This particular species is large and aggressive and it has been suggested that it could present a real threat to native flatworms. The biological information is extensive and so one learns that the British populations of some species are only known to reproduce asexually, that is by splitting. This ability to regenerate from fragments is one feature of flatworms familiar to anyone studying basic animal biology. This new Freshwater Biological Association Scientific Publication provides another valuable tool for those interested in freshwater habitats.

E.G. Hancock

Ecology of insects: concepts and applications

MARTIN R. SPEIGHT, MARK D. HUNTER AND ALLAN D. WATT

Blackwell Science, Oxford, 1999, 350 pp., softback with numerous monochrome and colour illustrations. ISBN 0 86542 745 3, £26.50.

The authors are to be congratulated on the production of this most comprehensive and detailed general account of the ecology of insects. The first chapter, "An Overview of Insect Ecology", outlines the scope of the subject and what follows in the next 9 chapters is a consideration in depth of the topics first raised in this section.

In "Insects and Climate" effects of temperature, photoperiod, rainfall, wind and climate change are discussed. "Insect Herbivores" deals with the feeding strategies of plant-feeding species and the defences plants put up to deter them. "Resource Limitation" concerns the growth potential of insect populations and the competition, both within and between species for limited resources. "Natural Enemies and Insect Population Dynamics" discusses predators, parasites and pathogens of insects and deals with the merits and limitations of the various mathematical models which have been formulated to explain population fluctuations associated with their activities. "Evolutionary Ecology" considers a wide range of topics including life history strategies, *r*- and *k*-selection, survivorship, longevity (in the sense of the length of life), fecundity, flightlessness, asexuality, coevolution, i.e. reciprocal evolutionary change between interacting organisms, ant-plant associations, insect-microbe interactions, the use of plant chemicals by insects for their own defensive purposes and the adaptations of insects to extreme environments. The short chapter "Insects and Ecosystems" deals with energy and ecosystems, insects and the terrestrial carbon cycle, insect decomposers and leaf-shredding insects in relation to stream ecosystems. An extended section on "Biodiversity and Conservation is followed by "Insects and Diseases" in which the role of insects in spreading diseases of plants and animals, including humans, is discussed. The final chapter, "Pest Management" reviews the various methods used to limit the depredations of various insect pests.

In all sections of the book the topics raised and views expressed are authenticated by reference to actual examples mainly drawn from recent publications and the bibliography of some 1395 titles, almost all in English, is impressive. The text is well-written and well-illustrated by numerous charts, graphs, tables and monochrome photographs. A section of 42 colour photographs helps to enliven the narrative.

In common with many books produced by modern techniques errors occur and a fair number were detected during a necessarily rapid read-through. These can be mainly classified into spelling mistakes and howlers. It would savour of nitpicking to detail all spelling mistakes but examples are *Cardimine* for *Cardamine* (p 59), mututually for mutually (p 64), *Lucilla* for *Lucilia* (p 83), *Pseuomyrmex* for *Pseudomyrmex* (p 146), Simulidae for Simuliidae (p 177) and *Amylosteruem* for *Amylostereum* (p 221). Howlers, however, are more serious; these include 47,000 as the number of described insect species (p 10 - true figure more like 950,000 (p 180), shield bugs are Heteroptera not Homoptera (p 44), *Anthrenus* is a dermestid, not an anobiid (p 149), termites produce CH_4 not NH_4 (p 176), tsetse flies have piercing but not blade-like mouthparts (p 237), fig 9.16 of a mosquito larva is upside down (p 242) and spruce trees are *Picea* not *Abies* (p 245). It is hoped that these errors, and others will be corrected before the next printing.

This is a valuable and up-to-date source book which should be possessed by all serious students and libraries.

Ronald M. Dobson

Irish indoor insects: a popular guide

JAMES P. O'CONNOR & PATRICK ASHE, ILLUSTRATED BY SEAN MILNE

Town House & Country House Ltd., Dublin, 2000, 180 pp., softback with numerous drawings. ISBN 1 86059 095 0, £16.99.

At the outset it must be said that although the title refers to Irish insects, the subject matter of this book, published under the auspices of The National Museum of Ireland, Dublin, is just as valid in Great Britain as in its parent country.

After a brief introduction in which the characteristics and variety of insects are reviewed in non-technical terms, details are given of the insects commonly associated with houses, shops, warehouses and other types of building. It includes many of the species associated with stored foodstuffs and other infestible commodities e.g. flour beetles, those which are associated with house plants e.g. fungus gnats, those which cause damage to premises e.g. woodworm, those which are parasitic on man and his domestic animals e.g. fleas, those which use buildings as home bases e.g.

wasps, and various strays which may wander in from the garden from time to time.

Individual species, or groups are characterised, many being illustrated, and their life habits, in relation to their significance indoors are discussed. Species of economic or public health importance are carefully distinguished from harmless strays. In many instances interesting and even amusing anecdotes regarding infestations within the Irish context are given.

In the final chapters control measures and insects in relation to human health are discussed in some detail and these are followed by a series of appendices dealing with design and construction of buildings in relation to minimising infestations, product liability claims and professional identification services. A glossary of technical terms, a good bibliography and an index complete the book.

On the whole the book has been well-produced and makes fascinating reading. It would perhaps have been worth while to have extended the coverage slightly to have included some of the non-insectan arthropods such as centipedes, millipedes, woodlice, spiders, harvestmen and mites which frequently occur in premises and a section on house-dust mites would have been valuable. A few errors were noted in the main text; lettuces are not brassicas (p 109) and the fertilised eggs of social Hymenoptera produce both queens and workers whereas the unfertilised ones produce males (pp 112, 119). Errors in the index were *Aceta* for *Acheta, Irodomyrmex* for *Iridomyrex, Lasiioderma* for *Lasioderma, Memestra* for *Mamestra* and in relation to *Pediculus humanus*, var. *coporis* for *var. corporis.*

Ronald M. Dobson

How to identify butterflies

RICHARD LEWINGTON

HarperCollins, London, 1999, 159pp softback with several coloured illustrations of each species, calendar bars and maps. ISBN 0-00-220123-2, £12.99.

This book is attractively laid out and aims to make it easy to identify butterflies of northern Europe. As we have now come to expect with anything associated with Richard Lewington, the illustrations are superb, many looking so good you would think they were photographs. Butterflies are depicted in the traditional way, showing upper and undersides, as in pinned specimens, but also as they are in life, often (but not always), on their larval foodplants or nectar sources. Caterpillars for all British species are illustrated, although eggs are not, which is a pity. A very useful point of the book is that it describes 'lookalikes', by comparing similar species. Although all British species are shown, a few (e.g. the green hairstreak) are only mentioned as 'lookalikes' and so do not have associated calendar bars (showing when the different stages of the butterfly's life cycle can be found) or maps.

Unfortunately I feel the book has tried to do too much. Flight periods are too general (to cover northern Europe), so giving the impression, for example, that the small blue is on the wing from May to September. (In Scotland this species generally flies for only 2-3 weeks in June/July). Distribution maps are too small and can give a very misleading idea of the true distribution. The small blue appears to occur in Orkney and Shetland, whilst the marsh fritillary appears to be absent from Scotland altogether! However, most readers will probably not notice these minor problems, and will find it a useful and informative book at an affordable price.

Richard Sutcliffe

Provisional atlas of British hoverflies (Diptera, Syrphidae)

STUART G. BALL AND ROGER K.A. MORRIS

Biological Records Centre, Huntingdon, 2000, 167 pp., paperback with maps. ISBN 1 870393 54 6, £8.00.

Copies available from Publication Sales, CEH Directorate, Monks wood, Abbots Ripton, Huntingdon, Cambridgeshire PE28 2LS. £8.00 includes p&p. Cheques payable to Centre for Ecology & Hydrology.

This atlas is the culmination of many years of work by the two authors, both pre-eminent in entomology in general and hoverflies in particular, plus a host of keen contributors. The resulting data form an excellent example of this genre of publication. The geographical coverage and accompanying information on biology can be taken as authoritative mainly as a result of the publication of Stubbs & Falk (1983, *British Hoverflies: an illustrated identification guide,* British Entomological and Natural History Society). This allowed the study of these generally common and beautiful insects to be made with confidence and with its colour plates of each species opened them to amateur naturalists for the first time. This series of publications has stuck with the running title 'Provisional Atlas of....' but recent titles have been quite definitive. The recording schemes are all still running so more records will gradually upgrade the map coverage but it is difficult to imagine a new edition appearing that will differ in anything but such detail.

Hoverflies are now probably only second to butterflies as the most popular insects in Britain, notwithstanding that there are many more species (266 hoverflies; 61 butterflies). In recent years a vast literature on all aspects of their behaviour, life cycles and other aspects of their biology has been built up. As a result the status of rarer species is known well enough for Red Data Book categories to be allotted accurately and Species Biodiversity Action Plans to be drawn up. Anyone interested in the group will be keen to add this volume to their library and naturalists with general interest in their surroundings would benefit from having it for consultation. Perhaps the only disappointment is the coverage for Scotland which although about average compared to other atlases could have been of much greater density if data known to exist had been incorporated. This is destined to be published separately and if it is sooner than later the two will provide a body of information on a scale that will be the envy of other countries of Europe if not the world.

E.G. Hancock

Seafish

BENT J. MUUS AND JOERGEN NIELSEN WITH ILLUSTRATIONS BY PREBEN DAHLSTROM AND BENTE NYSTROM

Scandinavian Fishing Yearbook and Blackwell Science, Oxford, 1999, 340 pp., hardback with over 700 colour illustrations. ISBN 87 90787 00 5, £39.50.

At last a small affordable species guide for the common sea fishes of northern Europe of a standard that we have expected for volumes on birds for many years. This completely new volume, first published in 1999, is intended as a sister volume to the "Freshwater Fish" volume by the same publishers which has been around for some time. It has a simple dichotomous key to lead you easily to the main fish families that is supplemented with keys to genera and species where appropriate. It has the principal identification characteristics of each species and most importantly, it has superb illustrations of the approximately 270 species which the volume seeks to cover. Its species distribution maps are clear and the text concise and well written throughout.

In addition to its identification function, this volume has an introductory chapter that outlines some basic biology of fishes, covering anatomy, sensory organs, reproduction, life-cycles and growth. In two final chapters the history of fisheries and the current fishing industry are covered. All of these subjects, although by necessity dealt with briefly, remain clear and concise but without oversimplification. The main part of the volume however, is the detailed coverage of around 270 marine species of the fin fishes from the north Atlantic and Mediterranean and it is in this, that this volume stands head and shoulders above other volumes of this kind. An excellent volume, that should be on the bookshelf of everyone interested in marine life.

Colin Adams

Freshwater fish

BENT J. MUUS WITH ILLUSTRATIONS BY PREBEN DAHLSTOM AND BENTE NYSTROM

Scandinavian Fishing Yearbook and Blackwell Science, Oxford, 1999 (new edition; first published 1967), 224 pp., hardback with numerous colour illustrations. ISBN 87 90787 01 3, £35.00.

A completely revised version of "Freshwater Fish" by Muus and Dahlstrom originally published in Danish in 1967, the original volume and its later English translation was a standard field identification text for freshwater fish species. This new volume is clearly intended as a companion to "Sea Fish" by Bent Muus and Joergen Nielsen. The two books are bound in the same distinctive cover and with the superb quality illustrations by Preben Dahlstrom gracing this volume on the freshwater fish as well as the volume of marine species, the success of this volume must be as assured for this alone. Irritatingly however, the text, format and publishing are not of the same quality as that of the marine fishes volume. For some reason the publishers have chosen to use lower grade paper for the Freshwater Fish volume and comparing the two volumes, there is little doubt that the high quality of the excellent illustrations is compromised in their reproduction. In addition, the text is not in a common format for the individual species descriptions (as it is in the marine volume) and there are one or two factual errors that have been missed in the revision. The publishers have also failed to add titles to the distribution maps where there are two or more species described on one page, and the reader is left to best guess which distribution map refers to which species. Also irritating is the title. This volume in fact only covers freshwater fish species from Europe but the author (or publisher) leaves that information to the inside cover in, what looks like, an afterthought. Despite these criticisms, the very high quality of the illustrations and detailed species text plus the clear and simple dichotomous keys will undoubtedly appeal to angler and naturalist alike.

Colin Adams

Dinosaurs: the Ultimate Guide to Prehistoric Life

CHRISTOPHER A. BROCHU, JOHN LONG, COLIN MCHENRY, JOHN D. SCANLON, PAUL WILLIS: CONSULTANT EDITOR MICHAEL K. BRETT-SURMAN

Harper Collins, London, 2000, 256 pp., hardback with numerous colour and monochrome illustrations. ISBN 0 00 710084 1, £17.99.

This book, dealing only with a restricted range of extinct vertebrates, is hardly "the ultimate guide to prehistoric life" indicated by the title. It does, however, give a broad and commendably detailed account of the dinosaurs and the world they inhabited. Although the group Dinosauria includes the largest land animals that ever existed, the majority of species were not the lumbering monsters of popular imagination: in fact the average size of the 860 or so described species was only about that of a sheep and some forms were no larger than hens.

The first four chapters are introductory, dealing with the geological time scale, the dating and interpretation of fossils, the environment of the Mesozoic era, the origins, characteristics, feeding and behaviour of dinosaurs, their relation to other contemporary vertebrates, the reasons for their near extinction and the case for regarding birds as descended from them. Some recent work is discussed and advice is given on fossil hunting and study.

Chapter five is the core of the book in which 79 genera of dinosaurs are considered in detail. Comments are made on the discovery, dating and probable habits of each and museums where their remains can be seen are indicated. Each account is supported by colour paintings of the form under consideration and separate components such as teeth and skulls are often figured. Although details such as colour are purely imaginary and comments on behaviour etc. are speculative this section probably gives as accurate a picture of dinosaurs and their environment as modern scholarship allows.

Chapter six, the final section of the book, deals with a selection of the most important museums and field sites where dinosaur remains can be viewed.

On the whole the book is attractive and well produced. There are a few typographical and similar errors but these are not serious enough to confuse the meaning except perhaps at the bottom of p 134 where the "Field Museum of Natural History, Chicago" is cited as the "Field of Natural History Museum". The classification table on p 23 would be better if it were extended to include the classificatory categories accompanying the description of each genus because at present the affinities of many of these can only be determined by constant reference to the combined index and glossary. The order of presentation of genera seems somewhat arbitrary. Surely it would have been preferable to have presented them in a systematic order. These criticisms apart, the book is a good buy and can be recommended to all interested in these fascinating animals.

Ronald M. Dobson

Who Killed the Great Auk?

JEREMY GASKELL

Oxford University Press, Oxford, 2000, 227 pp., hardback with black and white photographs, line drawings and maps. ISBN 0 19 856478 3, £18.99.

Following hard on the back of Errol Fuller's 1999 tome on *The Great Auk* it would seem difficult to add much that is new. Most reliable accounts of this extinct bird derive from publications by Alfred Newton and Symington Grieve who were among the first to research extensively its history within 50 years of its extinction. The last reliable record of the living Great Auk came from the account of the breeding pair killed at their egg on Eldey Island in June 1844, probably around 3 p.m. The author here, like others before him, has tried to include post-Eldey sightings and accounts of notional non-breeders floating around in northern seas. Personally I find most of these can be dismissed as inaccurate or flawed (e.g. midwinter records of birds described in summer plumage) or even confused with the Great Northern Diver, a species flightless during the autumn period of primary moult. However there is much to chew over and analyse. In this book there are accounts of the Great Auk at its Scottish localities and chapters on it from Iceland, the Faroes and Newfoundland as well as its natural history and its role in modern bird protection.

As an inveterate filer of Great Auk data I would be happy to include this book among my references. The author is to be congratulated on finding more information on this fascinating and lamented indigenous species. The book is well researched, well written and well enjoyed.

Bernard Zonfrillo

Essentials of animal behaviour

P.J.B. SLATER

Cambridge University Press, Cambridge, 1999, 233 pp., softback with black and white photographs and drawings. ISBN 0 521 62996 9, £11.95.

Essentials of Animal Behaviour is a revision of *An Introduction in Ethology*, Peter Slater's previous book for Cambridge University Press. This was published in 1985, reprinted in 1987 and is now out of print. To assess this revised and renamed version one needs to answer two questions. The first is, given that a great deal has changed in behavioural research since the original book was first published, how much new material does the revised version include? The second is, regardless of how much of its content is new, how useful is the book?

The answer to the first question is 'rather little'. The preface describes the text as extensively modified, but this is not really the case. I had to hand my copy of *An Introduction to Ethology* and going through the two books page by page, I found that the print is a little sharper and some of the figures have been redrawn, though this is not always an improvement; the cover design is a case in point. In addition, some sections have been moved to different chapters (for example, a section on social learning has been moved from Chapter 9 to Chapter 5), some examples have been replaced by more recent work (for example, a study using genetic fingerprinting is included in the section on Strategies of Reproduction) and there are a couple of short new sections (for example, on motivation and animal welfare). However, overall, I would guess that about 95% of the text is unchanged, so we are looking at essentially the same book. Therefore for those readers of this journal who have access to Peter Slater's *An Introduction to Ethology* I would suggest that the revised version is of limited value.

However, *An Introduction to Ethology* is out of print, so how well does this replacement version fulfil its aim, identified in the author's preface, of providing a brief but reasonably comprehensive introduction to the study of animal behaviour for first and second year undergraduates? Peter Slater, the Kennedy Professor of Natural History at the University of St. Andrews, is an experienced and gifted teacher and this shows in the way the book is written. The style is simple, clear and readable and (arguably), Slater manages well the difficult task of making jokes in a textbook. The level is also well pitched for the intended audience, being rigorous and authoritative but making few assumptions about the reader's existing expertise. Rather than attempting an exhaustive account of all behavioural research, Slater has chosen to use a few key examples that he presents in sufficient detail to illustrate his themes, and this works very well. There is an extensive glossary of terms at the end of the book and a helpful list of further reading, since the book is deliberately not fully referenced.

What about coverage? The book starts with an introductory chapter on the recent history of the biological study of behaviour and of the acrimonious but ultimately productive interaction between the European ethologists and North American psychologists, outlining the main questions that biologists ask about behaviour (causation, development evolution and function). In time-honoured tradition, the next six chapters look at these questions in turn; chapters 3-4 are about the causation of behaviour (the neurobiology of motor patterns, sensory biology and studies of motivation), chapter 5 is about behavioural development and learning, chapter 6 about behavioural genetics and the phylogeny of behaviour and chapter 7 about the functions of behaviour, illuminated by insights from Behavioural Ecology. The final two chapters take an essentially functional look at two related aspects of behaviour, namely communication and social organisation. Coverage in all these areas is critical and thorough and any student reading this book will end up with a sound understanding of the basic principles of behavioural biology.

Like its predecessor, therefore, *Essentials of Animal Behaviour* soundly and usefully achieves its stated aims and so is to be recommended. All the same, I found it a bit disappointing. While it may be true that the general principles of animal behaviour are unchanged, the book fails to convey the excitement of many recent developments in behavioural research that illuminate and extend these principles. To give just two examples, important new research in behavioural neurobiology and endocrinology have brought us much closer to a physiological understanding of the mechanisms that generate adaptive behavioural variation, while the development and application of modern molecular tools to behavioural phenotypes has facilitated major advances in behavioural genetics. These and other recent developments are not reflected in Slater's revised book. No doubt it is unfair to criticise an author for not having written a different book, but with his experience and breadth of vision, Peter Slater would seem to be ideally placed to write a book that combines a broad introduction to behavioural research with glimpses of these exciting new developments. Next time perhaps?

Felicity Huntingford

Books received

The following have been received but it has not been possible to review them for this issue. Full reviews will appear in the next issue.

Wetland Ecology. Principles and Conservation. Paul A. Keddy, Cambridge University Press, 2000. £32.95.

***Fossils and Evolution.* T.S. Kemp, Oxford University Press, Oxford, 1999, £14.99.**

PROCEEDINGS 2000

The Chairman, place*, number present, lecturers name and title of lecture are given for most meetings.

*BOB Boyd Orr Building

GKB Graham Kerr Building

11th January
Bob Gray, GKB, 27,31st Paisley International Colour Slide Exhibition, Natural History Section, Compiled by members of Paisley Colour Photographic Club and presented by Wineford Brown and projected by Jim Campbell.

8th February
Bob Gray, GKB, 53, "Lusitanian Fungi or no! Larger Fungi of West Scotland", speaker, Professor Roy Watling.

22nd February
Bob Gray, GKB, 32, 70th AGM. Reports were presented on activities during 1999, and elections held, resulting in appointments as shown opposite. Membership stands at 244 made up of 195 ordinary, 22 family, 13 junior, 4 school and 10 honorary members. There were 3 Council Meetings and the executive met informally as required.

AGM followed by an illustrated talk -"The Glasgow Science Centre", by Dr Graham Durant.

14th March
Bob Gray, GKB, 31, "The Frogs of Trinidad: old fashioned natural history, or will we make a fortune with our new car tyre design", speaker, Dr J. Roger Downie.

13th April
Bob Gray, GKB, "Birds of Bolivia", speaker, Ross MacLeod.

9th May
Bob Gray, GKB, 15, "The Wildlife Garden in Glasgow University", speaker, Dr Judy Wilkinson.

13th June
Summer Social to Balmaha.
23 Excursions took place during the year.

1st October
Bob Gray, GKB, welcomed members to the Exhibition Meeting with Wine and Cheese.

12th October
Bob Gray, GKB, 30, Goodfellow Lecture, Dr Robert W. Girdwood (Stobhill Hospital) - "More Crawlies than Creepies".

26th October
Bob Gray, GKB, 32, Members Slide Night, 6 Members presented varied slide shows.

9th November
Bob Gray, GKB, 29, "Orangutans - Our Indonesian Cousins", speaker, Lisa Mather.

13th December
Bob Gray, Glasgow University College Club, 42 attended an excellent Christmas Dinner and after the meal Kate Aird & Joan Chapman showed slides of their trip down the River Yangtse, China.

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THE GLASGOW NATURALIST

Advice to Contributors

1. The Glasgow Naturalist publishes articles, short notes and book reviews. Book reviews are commissioned by the Librarian and all books reviewed are kept in the Society's Library. Articles and short notes should be sent to The Editor, Glasgow Naturalist, c/o Natural History Department, Museum and Art Gallery, Kelvingrove, Glasgow G3 8AG. Short notes are edited by Mr A. McG. Stirling. Articles are refereed by the Editorial Board. Final acceptance of articles and short notes is the responsibility of the Editor. The journal is usually issued in May each year. The subject matter of articles and short notes should concern the Natural History of Scotland in all its aspects, including historical treatments of natural historians.

2. Short notes should not normally exceed one page of A4 single-spaced. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. There should be no other sub-headings. Any acknowledgements should be given as a sentence before the references.

Short notes may cover, for example, new stations for a species, rediscoveries of old records, additions to records in the Atlas of the British Flora, unusual dates of flowering, unusual colour forms, ringed birds recovered, weather notes, occurrences known to be rare, interesting localities not usually visited by naturalists, and preliminary observations designed to stimulate more general interest.

3. Articles should be more substantial than short notes, and have no upper limit of length. They should be headed by the title and author's name and address. Any references cited should be listed in alphabetical order under the heading References. The text should normally be divided into sections with sub-headings such as Introduction, Methods, Acknowledgements, etc.

4. References should be given in full (please do not abbreviate journal titles) according to the following style:

Pennie, I.D. (1951). Distribution of Capercaillie in Scotland. *Scottish Naturalist* 63, 4-17.

Wheeler, A. (1975). *Fishes of the World.* Ferndale Editions, London.

Grist N.R. & Bell, E.J (1996). Enteroviruses. Pp. 381-90 in Weatherall, D.J. (editor) *Oxford Textbook of Medicine.* Oxford University Press, Oxford.

5. The nomenclature of vascular plants should be as in Stace, C.A. (1997). *The new Flora of the British Isles*, (Second Edition) Cambridge University Press, Cambridge. Normal rules of zoological nomenclature apply.

Please use lower case initial letters for all common names e.g. wood avens; blackbird, unless the common name includes a normally capitalised proper name e.g. Kemp's ridley.

Where giving distribution information by vice-county, use the following style: VC 30.

6. Submitted manuscripts (two copies) should be typed double-spaced on A4 paper. Once a manuscript has been accepted, typesetting is greatly assisted if the manuscript can be supplied on a microcomputer diskette. Authors are therefore strongly encouraged to produce manuscripts using a wordprocessor (preferably on a PC-compatible microcomputer). However, to assist amateur naturalists, the Editor can make arrangements to have hand-written manuscripts typed.

7. Tables are numbered in arabic numerals e.g. Table 1: they should be double-spaced on separate sheets with a title and short explanatory paragraph underneath.

8. Line drawings and photographs are numbered in sequence in arabic numerals e.g. Fig. 1. If an illustration has more than one part, each should be identified as 9a), (b) etc. The orientation of the figure and name of the first author should be indicated on the back. They should be supplied camera-ready for uniform reduction of one-half on A4 size paper. Line drawings should be drawn and fully labelled in Indian ink, dry-print lettering or laser printed. A metric scale must be inserted in micrographs etc. Legends for illustrations should be typed on a separate sheet. The Editor is able to accept a small number of high quality colour photographs for each issue.

9. Proofs should be returned to the Editor by return of post. Alterations should be kept to the correction of errors. More extensive alterations may be charged to the author.

10. Ten offprints and one complimentary copy of the Journal are provided free of charge. Further copies may be purchased, provided that they are ordered at the time the proofs are returned.

11. All submissions are liable to assessment by the Editor for ethical considerations, and publication may be refused on the reeommendation of the Publications Committee.

Acknowledgements

The Editor wishes to thank Irene McLaren for typing. Norman Tait for preparing the photographs, and Universities Design and Print for their expert printing work.

Front Cover

Watercolour illustration of a goldcrest (1) and a firecrest (2) from the Glasgow Naturalists Society *Manuscript Magazine,* 1863. This is Figure 1 of Richard Sutcliffe's article on the Glasgow Natural History Societies, from page 61.

Back Cover

Two photographs from the Society's archives. This is Figure 6 of Richard Sutcliffe's article on the Glasgow Natural History Societies, from page 62.

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From the Society Picture Archives

Members of the Andersonian Naturalists Society pose for the camera during an excursion to Inchtavannoch, Loch Lomond, 22nd May 1890.

Dressed in period costume, members of the Glasgow Natural History Society celebrate the centenary of the Andersonian Naturalists Society in 1985

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THE GLASGOW NATURALIST
Volume 23, parts I-VI plus Supplement
1996 - 2001

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The editor wishes to thank R.M. Dobson for the huge effort he put into the compilation of this index.

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